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Volume 3 Number 1

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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The value of this publication will be determined by what Forest Service officers, State forestry workers, and private operators contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire-fighting methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Because of unforeseen circumstances volume 2, 1938, consisted of but one issue. Yearly subscribers will, however, receive four complete copies of the publication.

RECENT DEVELOPMENTS IN LOOKOUT TOWERS

H. R. Jones

Assistant Chief Engineer, Division of Engineering, U. S. Forest Service, Washington, D. C.

The issue between steel and timber lookout towers has been the subject of vast amounts of correspondence, charges, counter charges, and high emotions. The author, however, presents here a dispassionate factual statement on the present status of tower purchases and designs.

Previous to 1933 lookout towers purchased on the basis of plans and specifications were of structural steel.

About that time there were coming into use in this country, timber connectors which, in comparison with ordinary bolted or spiked joints, greatly facilitated the transmission of stress through joints in timber structures. The connectors as used in Forest Service lookout-tower construction consist of metal rings which are placed between two timbers, the connecting bolt passing through the center of the ring. The ring, with half its width projecting into the contacting face of each timber, transmits the stress from one timber to the other. These connectors are commonly used in CCC portable camp buildings.

The development of the timber connectors and resultant increased possibilities for economical use of timber led to its consideration for lookout towers, a matter in which the lumber industry and the Forest Service were much interested. An attempt to purchase towers showed that the industry was not prepared to produce prefabricated timber in competition with the steel industry, where prefabrication was a long established practice. However, in view of the Forest Service's interest in developing the economical utilization of woods, eight towers were purchased on a specification restricted to timber, as an experimental project. Reports of this project indicated that fabrication was decidedly defective, causing long delays during erection. As a result, tower bids were again limited to steel.

Pressure on the Forest Service to consider timber gradually increased as the timber industry improved its methods of prefabrication and the large purchases of towers in connection with the CCC program so stimulated this pressure that the subject was reopened.

In the meantime, some timber designs had been worked up in the regions. Region 6, which had been the most active in this connection, was asked in August 1936 to review the entire tower problem, considering comments and plans from all Forest Service regions. The study consumed 5 months. The report indicated conclusively that prefabricated timber structures could compete with steel, at least on the Pacific coast, and since plans for some timber towers were practically completed, a purchase then about to be made was handled on bids providing alternate offers on timber and steel. On that and subsequent proposals there have been purchased 135 timber towers.

Region 6 timber designs and Region 7 steel designs were selected as standard to be used for all purchases of towers within the range of sizes and heights they included.

In order to provide steel and timber plans for towers of practically equal heights—a necessary condition for competitive bids—considerable revision of existing steel plans and new steel designs was made in Region 7. Designs have now been completed for the following towers:

Towers for 14- by 14-foot lookout houses: Steel—30 feet, 41 feet 3 inches, 54 feet, 67 feet, 83 feet 1½ inches, 100 feet 4½ inches, 120 feet. Timber—30, 41, 54, 65, 83, 100, and 117 feet.

Towers for 7- by 7-foot cabs: Steel—30 feet, 41 feet 3 inches, 54 feet, 67 feet 6 inches, 82 feet 6 inches, 99 feet 9 inches, 120 feet. Timber—30, 40, 52, 66, 82, 99, and 119 feet.

Height is measured from top of footing to approximately the cab floor level.

The Washington Office usually purchases timber or steel towers for 7- by 7-foot cabs complete with timber or steel cabs. Towers for the 14- by 14-foot house are purchased usually without the house which is made of lumber for both timber and steel towers. Purchase and erection of the house are handled by the office ordering the tower. A recent purchase was made of steel towers complete with prefabricated lumber houses, and it is hoped that this will prove feasible.

The specifications recently used for competitive bidding between steel and timber do not take into account any differences, advantages, or disadvantages of the two materials, except that freight charges are considered and purchases are on the usual basis of lowest cost at rail point to which shipment is made. The specifications, therefore, may not actually provide for competition on a truly equal basis. The problem of arriving at equality in this respect is complicated by the fact that a few of the differences are considered to be debatable, and others vary with locality. To illustrate:

(*a*) Fire hazard is considered to be a disadvantage of timber. Treatment with fire resistant material is a possible development.

(*b*) Depreciation or life term is considered equal. No records are available which would substantiate a difference here, assuming that the time consideration is held within a period usually applied for accounting purposes.

(*c*) Maintenance costs are unknown, but records are being obtained. A period of several years will elapse before conclusive figures are available.

(*d*) In the eastern part of the country inspection costs have been greater for timber than for steel. Because of inadequate inspection some poor material has been received recently, necessitating reinspection of towers at several places. Accurate fabrication is a prerequisite for economical erection, and it is reasonable to expect that some day prefabricated timber of standardized quality of material and workmanship on a par with the product of steel fabricating shops will be available.

(*e*) Records have been kept of the erection costs of timber towers, and erection costs will be kept on the steel designs which will provide accurate comparative information.

(*f*) The cost of lightning protection is greater for the timber tower.

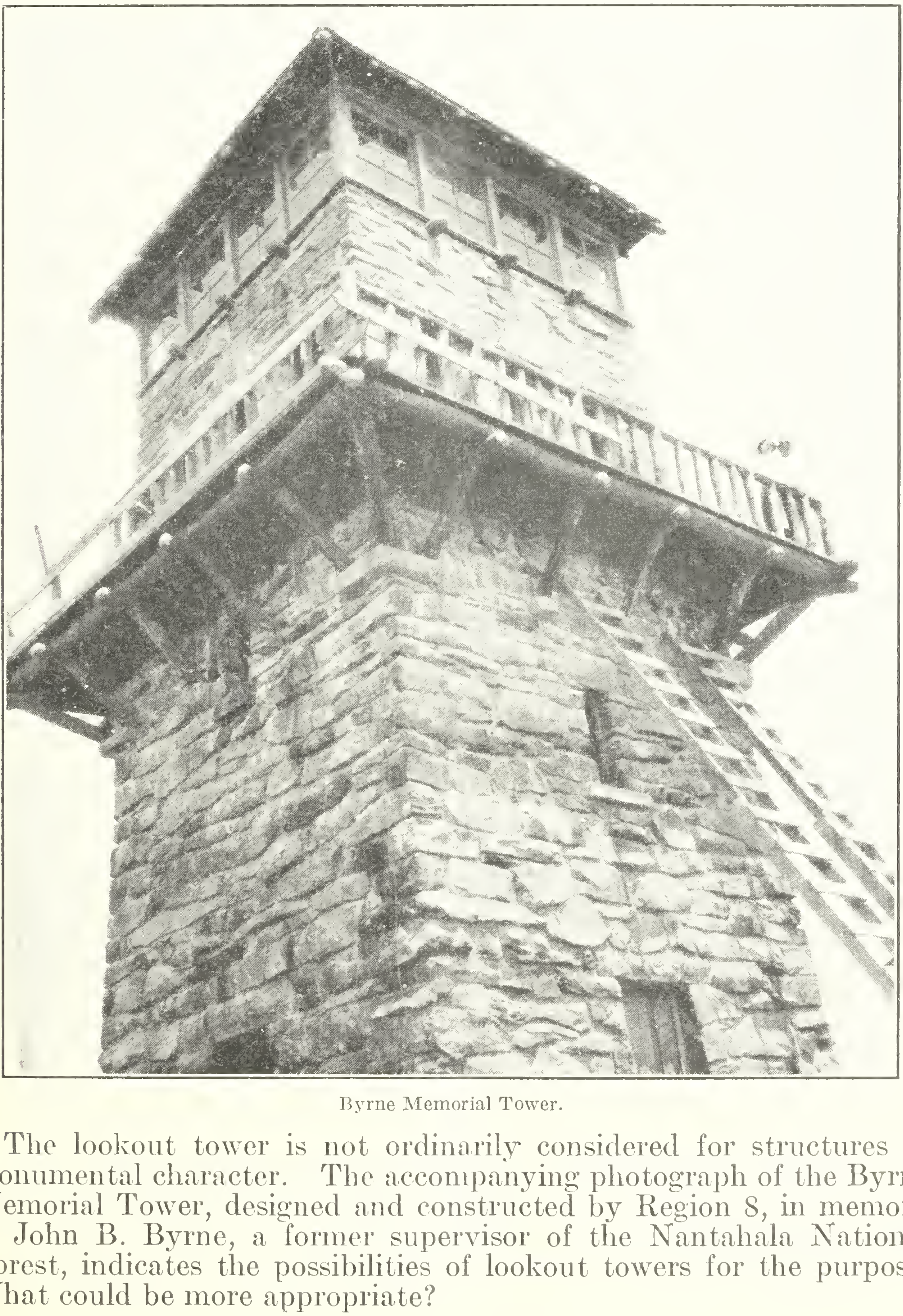
(*g*) Transportation from railroad to tower site is more costly for the timber tower because of its greater weight, particularly where pack horse transportation is necessary. Comparative weights taken from the Region 6 report will illustrate this point:

Shipping weights of 100-foot tower and 7- by 7-foot cab

	Pounds
Steel	18, 200
Timber, Douglas fir	27, 000
Timber, southern pine	31, 000

These weights do not include cement, sand, gravel, or water for the concrete footings. Total hauling costs will be influenced by the local conditions controlling the availability of these materials.

If hauling cost per ton-mile from rail point to tower site were definitely determined, it would be a simple matter to consider this cost difference in making award. Similarly, the other differences, insofar as they can be definitely determined, could be evaluated.



Byrne Memorial Tower.

The lookout tower is not ordinarily considered for structures of monumental character. The accompanying photograph of the Byrne Memorial Tower, designed and constructed by Region 8, in memory of John B. Byrne, a former supervisor of the Nantahala National Forest, indicates the possibilities of lookout towers for the purpose. What could be more appropriate?

DETERMINATION OF THE RATE OF SPREAD OF FIRE IN THE SOUTHERN APPALACHIANS

George M. Jemison

Associate Forester, Appalachian Forest Experiment Station, U. S. Forest Service

Rates of spread vary in a bewildering way. It would be easy to yield to the temptation to throw up our hands and say that it is useless to try for anything but good guesses at the rate a given fire will spread under given conditions of fuel, weather, and topography. The saner attitude is to keep digging away at the effect of this or that factor on rate of spread in the belief that in time the intricate puzzle will be solved by the creation of something that can rightfully be called the science of rate of spread. The author is doing just this for the specific combinations of conditions involved in the southern Appalachians.

Rate of spread of fire in specific fuel types under given conditions influences all major phases of forest-fire control, but accurate data on this subject are difficult to obtain. Estimates only are often used as a basis for planning fire-control needs.

Concepts of fuel type and fire-danger rating are new, especially in the East, and the probable rates of spread associated with different combinations of fuel type and fire danger are difficult to estimate. Actual measurements of fire behavior are desirable for even preliminary presuppression and suppression plans.

Three possible ways of obtaining rate of spread data for different fuel types and fire-danger classes are: (1) Analysis of fire reports accumulated in past years; (2) observation of actual forest fires; and (3) study and measurement of experimental fires ignited in specific fuel types and burning under measured conditions.

Because most fire reports contain no data from which fire-danger class and fuel type can be obtained without intimate knowledge of the fires in question, the first method usually yields a limited amount of fire-behavior information. This method has an additional disadvantage because rate of spread in chains of perimeter per hour must be derived from estimates of perimeter on arrival and hours since origin or discovery. The figure obtained on rate of spread is likely to be biased because of the tendency to overestimate perimeter in rough country under the pressure that usually accompanies arrival at a fire. Since time of origin is seldom known accurately and some spread usually precedes time of discovery, the use of either of these as a basis for computing elapsed time results in some degree of error. Finally few fire-danger rating schemes permit determination of danger class from fire reports, because fuel-moisture content at the time of a fire is seldom known.

The second method requires a large, well-trained, and widely distributed group of observers if the study of actual fires is to be profitable. It is probably more adaptable to eastern fires, where th initial attack usually is made by crews, than it would be in the West, where smoke chasers are used.

The use of experimental fires, a very desirable method, requires expensive preparations and is all but impossible in mountainous regions where fire behavior is complicated by topography, a variable difficult to control. Also, the hazard in setting fires on days of high danger in fast rate-of-spread fuel types prevents study of fires under extreme conditions. This is especially significant in most forest regions, because major losses in acreage and greatest suppression costs result from a few bad fires. On the Pisgah National Forest in North Carolina, for example, during the past 6 years, only 3 percent of the 466 fires accounted for 56 percent of the burned acreage. All of these fires occurred on days when the fire danger was class 4 or 5, the two highest ratings on the Appalachian fire-danger meter. Similarly, 40 percent of the total suppression costs were required by only 12 percent of the total number of fires, eight out of ten of which burned on class 4 or 5 days.

The Appalachian Forest Experiment Station, cooperating with Forest Service Regions 7 and 8, has combined methods 1 and 2. The approaches used may be of interest to others.

Rather than attempt to rate fuel types in the conventional terms of low, medium, high, and extreme rate of spread and resistance to control, 14 modified timber types were defined with special reference to the factors thought to contribute most to spread and resistance. The initial procedure of classifying fuel types in the Appalachians, which differed somewhat from the methods used elsewhere, was started by the Region 7 office of fire control in cooperation with the experiment station. It is believed that much more uniform recognition of these basic types by field men is made possible by this method. Of course, the 14 types can be reclassified into low, medium, high, and extreme groups as soon as rate of spread and resistance to control becomes definitely established for each type.

The first approximations of rate of spread and resistance to control were made in September 1937, by C. A. Abell, then of this station, who used data from reports of 1,560 fires on which fuel type had been identified by Region 7 rangers. The descriptive classification of the 14 types enabled these men to code the fire reports for the past 7 years and show the fuel type in which each fire burned. Although no attempt was made to correlate rate of spread and fire-danger class by fuel type in this preliminary study, the data were arbitrarily divided into groups to represent ordinary, moderate, severe, and extreme burning conditions.

The first determinations of fire occurrence and behavior in relation to fire danger were made from analysis of Pisgah National Forest fire records for 1932 to 1937. Such an analysis of reports for previous years could be made because the present form of the Appalachian fire-danger meter permits the rating of danger from the records obtained at any first order weather station. The analysis,[1] in part, produced the results shown in table 1. These data must be considered as preliminary because they are averages for two major fuel types, and danger classes were determined from only one station. However, the trends are very definite and the relation between danger classes is well shown.

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[1] For a complete report of this analysis see Technical Note No. 27, February 1, 1938, Appalachian Forest Experiment Station, Asheville, N. C.

TABLE 1.—*Relation between class of fire danger and occurrence, rate of spread, and area of fires* [1]

Class of fire danger	Occurrence probability		Percent of class days on which fires occur	Rate of spread, perimeter per hour (origin to arrival)		Average perimeter increase per hour during corral	Average final area per fire
	Fires of all causes	Exclusive of debris burner and incendiary fires		All fires	Fires attacked within 12 hours		
				Chains	*Chains*	*Chains*	*Acres*
1	1.0	1.0	2.5	1.3	4.6	3.2	3.9
2	1.8	1.4	5.5	3.2	7.1	6.0	4.2
3	8.0	4.0	18.0	8.2	10.6	8.0	7.4
4	22.8	9.5	39.0	12.8	17.1	9.1	25.0
5	56.2	28.6	59.5	16.2	20.0	9.9	45.8

[1] Based on 440 to 467 fires on the Pisgah National Forest, 1932–37, inclusive. Class of fire danger from Asheville, N. C., weather records, using Appalachian fire-danger meter.

The preliminary rate-of-spread data for the various fuel types and danger classes are being systematically checked on the southern Appalachian Mountain forests by a corps of 125 trained CCC fire observers. This work was carried through the 1937 fall and 1938 spring fire seasons, and some features of it have produced worthwhile results. These fire observers, who are carefully selected and trained by the station, accompany suppression crews to fires and have no duties other than measuring and recording certain data on fire behavior.

When an observer reaches a fire, his first job is to mark its perimeter by blazing a line around it as quickly as possible. If fires are in very rough country or are so large that to encircle them would require more than 20 minutes, the fire boss supplies an estimate of perimeter, as in the past. When the blazing method is used, the observer, with an assistant, carefully chains the marked perimeter after the fire has cooled down sufficiently for him to locate the blazed line. In many cases this method supplies a more accurate rate of spread figure than would otherwise be obtained.

Rangers or their assistants are responsible for identifying the fuel type at the spot of the fire as one of the 14 standard classes. Observers were initially trained to describe character, volume, and arrangement of dead fuel on the ground, but because of the varying conditions on actual fires and the resulting confusion this phase o the work was soon dropped.

Fire observers are equipped with four 16-ounce tin sampling can in which they collect surface litter. These samples are mailed t the station, where the fuel-moisture content is determined. Thi procedure furnishes more accurate fuel-moisture data for dange rating than does measurement at an established fire-danger statio some distance from the fire.

Other factors necessary for rating fire danger are obtained at th nearest danger station while the fire is burning, a procedure probabl satisfactory for rainfall and humidity. Wind velocity varies greatl with locality, however, and measurements at the nearest statio may not truly indicate winds at the fire. An attempt was made t train fire observers to estimate wind velocity, but this was discon tinued when it became apparent that the results were grossly i error. Unfortunately, the use of wind instruments is too expensive.

The essential features of the method of rate-of-spread determination used by the Appalachian station in cooperation with Forest Service Regions 7 and 8 are:

1. Classification of fuel types strictly on the basis of stand characteristics with special reference to dead fuels. Although requiring a more detailed initial classification this procedure is more accurate than some of the others because it eliminates chances for personal errors.

2. Analysis of fire reports to obtain preliminary rate-of-spread data for each fuel type. This method of fuel-type classification facilitates accurate identification of fuel type for each fire report.

3. Preliminary determination from fire reports of fire behavior associated with each class of fire danger. Definite trends of differences in rate of spread under different conditions can be established by this method.

4. A detailed check of preliminary rate-of-spread determinations by means of observations on going fires. Experience has shown that CCC observers can obtain better measurements of perimeter on arrival than have been obtained in the past. Collection of fuel samples at fires for later moisture determination is well worth while, but in the Appalachian region estimation of wind velocity and detailed description of character, volume, and arrangement of fuel has not proved satisfactory.

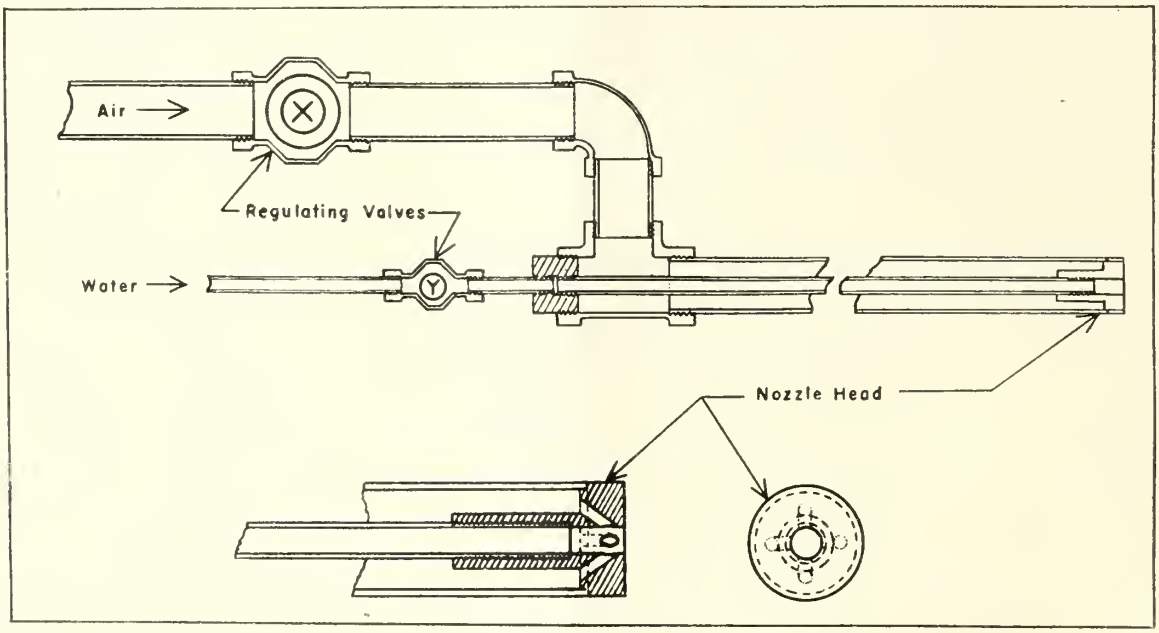
TESTS ON THE USE OF COMPRESSED AIR IN FIRE SUPPRESSION

C. Lorenzen, Jr.

Formerly junior engineer with the California Forest and Range Experiment Station, U. S. Forest Service

Everyone knows that the efficiency of 10 gallons of water in fire suppression depends on the way it is used. Testing the relative efficiency of chemicals and water doesn't mean much unless the water is used in the most efficient way. What is the most efficient way of using water? In a solid stream? In the form of spray? Under high pressure? Or low pressure? Mixed with air under pressure? If mixed with air, how much air, how much water, and under what pressures? The author records one attempt to find more efficient ways of using water.

The use of compressed air in fire suppression has been suggested to control backfire, to remove litter in fire-line construction, and to increase the efficiency of water. At the Spokane fire-equipment conference (1936) this subject was assigned to the California Region for investigation.

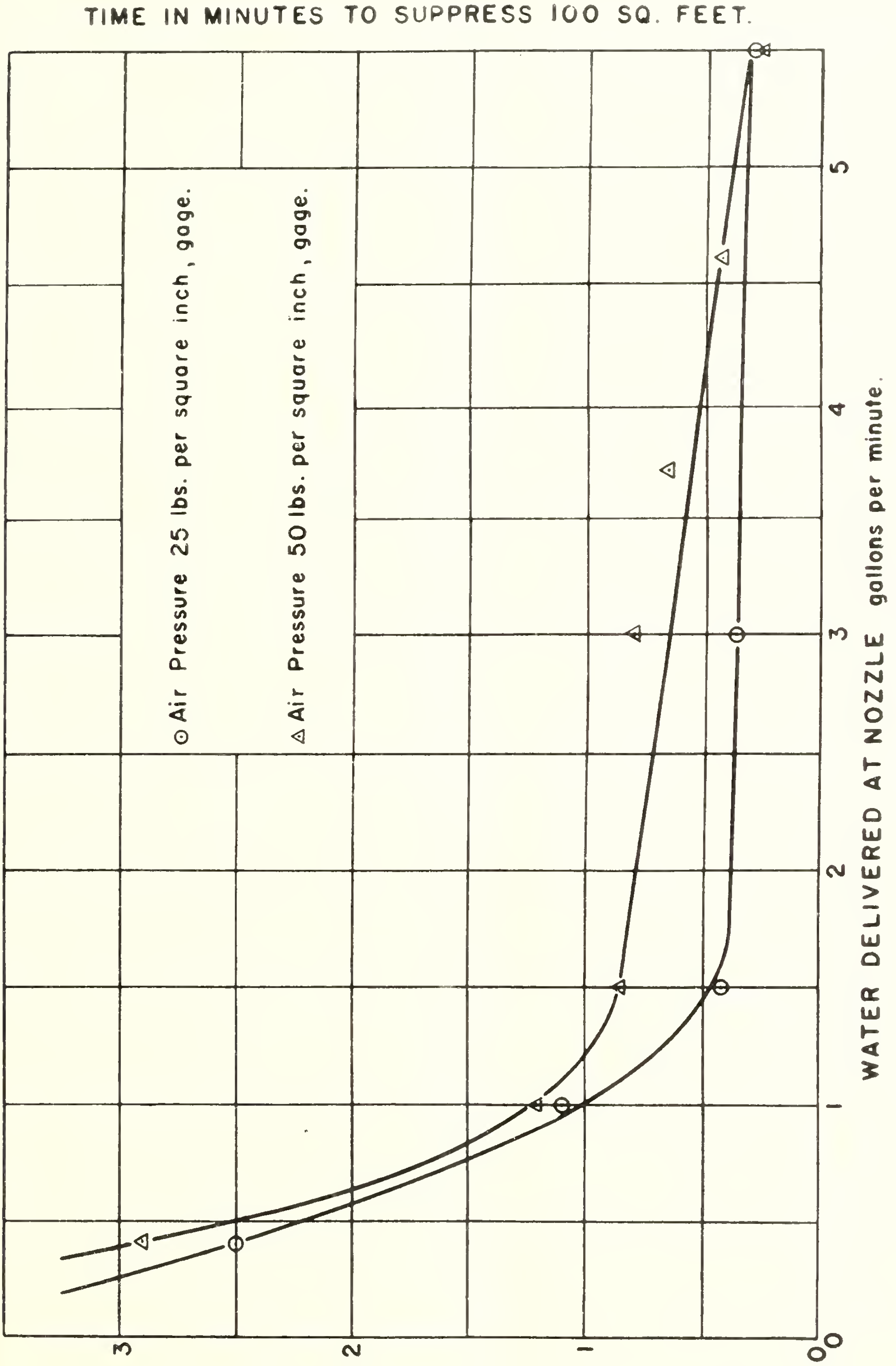


Air-water nozzle.

A few preliminary tests served to demonstrate the impracticability of using compressed air for the rapid removal of forest litter in fire-line construction. The remaining tests were concerned with the use of air-water nozzles for fire suppression.

After some experimenting a nozzle embodying a mixing chamber was developed by F. C. Lindsay, formerly on the Plumas National Forest, for obtaining different air-water rations. Water pressure was kept constant at 30–40 pounds. The water-flow rate was varied by adjustment of a regulating valve in the line.

To test the efficiency of the nozzle at various air-water ratios, 17 small fires, averaging from 10 to 15 feet in diameter, were burned in fairly clear plots of ponderosa pine litter. The fires were set under conditions of little or no wind and were allowed to spread to a predetermined size. The rate of suppression with the nozzle was then measured, the time to knock down the flame and to completely mop up the smouldering litter being recorded. Water for the tests was supplied from a 450-gallon tank truck, and air was obtained



Air-water ratio efficiency.

from a portable compressor. Water pressure of 30–40 pounds per square inch gage was held constant throughout this series of tests, and water-flow rates over the calibrated range were used at air pressures of 25 and 50 pounds per square inch.

The data obtained in these tests (see chart) show that there exists a very definite optimum value of water rate for a given air pressure. For higher air-water ratios (above this region) the effectiveness of the nozzle drops rapidly, while for lower ratios there is a rapidly increasing waste of water. The curves show the optimum occurring at a water rate of about 1¾ gallons per minute for an air pressure of 25 pounds per square inch. The curves for air pressures of 50 and 100 pounds per square inch were of similar shape. For these rates the data indicate that any air pressure above 50 pounds per square inch is undesirable.

Comparison of the action of the air-water nozzle with that of the conventional water-spray nozzle was obtained on six additional ponderosa pine test fires. In each test a plot was measured, divided into two equal areas, and burned off. The different methods were then applied to the two areas and the total mop-up times recorded. The water rates for both methods were equal in each case, giving a direct indication of the effect of the addition of air to the water. The time difference in each test was too small, compared to the total suppression time, to indicate any superiority for the air-water nozzle. Similar suppression time tests on 6-foot sections of burning logs showed no appreciable time difference between the use of water-spray and air-water nozzles.

Although the tests showed that the air-water nozzle was not superior to the water-spray nozzle for fire suppression, two valuable suggestions were obtained. First, the optimum air-water ratios found suggest that optimum flow rates and nozzle types for given water pressures could be determined by similar experiments for water-spray nozzles. Second, while the additional oxygen supplied the fire by compressed air is a disadvantage, the force added increases the penetrating power of the stream without increased water consumption. It would, therefore, appear desirable to test the use of CO_2 gas under pressure in lieu of compressed air.

FOREST FIRE-FIGHTING PUMPS

Forestry Branch, Department of Lands and Forests, Ontario, Canada

Fire Control Notes hopes to serve fire-control men in Canada as well as in the United States. This contribution on fire pumps is, therefore, particularly welcome. Moreover, a discussion on portable pumps is very much in point on the southern side of the international boundary at this time. A special effort is being made by the Forest Service of the U. S. Department of Agriculture to raise specifications—and get manufacturers to follow. This organization, like the Ontario Forestry Branch, leans toward lighter weight for portable pumps. The present specification prescribes not to exceed 75 pounds for one-piece units and not to exceed 100 pounds for two-piece units. In the two-piece units the heavier of the two pieces may not exceed 60 pounds.

During the last 25 years or more manufacturers have been designing and building different types and sizes of gasoline-driven, portable, fire-fighting pumps for use in forest-fire protection, with the idea of finding one unit which would be satisfactory to all forest-protection organizations. Such a unit seems to be but another dream; certainly it has not yet materialized. Possibly the protection organizations are expecting too much, but some are still striving to obtain units suitable to their own particular set of conditions, one organization leaning more toward a heavier unit, another toward a lighter unit. Ontario falls in the latter class.

The general specifications of a fire-fighting unit most suitable to meet conditions in the Province of Ontario call for one which would be:

1. As light as good construction and simple reliable operation will permit, weight in any case to be less than 100 pounds.
2. Compact and of a form suitable for back packing and aircraft shipment; the unit to have a low center of gravity and wide base, in proportion to size, for ease in set-up; delicate or easily damaged parts to be protected, as far as possible, by the design of the unit.
3. Capable of pressures up to 200 pounds (higher pressures are not desired in view of the danger of hose damage); volume capacity to be as uniform throughout the unit's working range as practicable; unit to deliver at least 20 gallons per minute at 150 pounds pressure.
4. Capable of operation against any variation of load on the hose line, so that the entire flow may be cut off or the unit operated against no load without damage to the unit or interruption in water supply.
5. As economical of fuel and oil as is consistent with the required pressure and volume capacity.
6. Easy and economical to repair and service.

In attempting to construct a unit suitable to conditions in Ontario and with these rather severe limitations, it was necessary to investigate the capabilities of a great number of possible combinations of motors and pumps, since no existing unit fulfilled the requirements. The unit which has finally been assembled has characteristics which can be conveniently listed against the stated requirements as follows:

1. Weight approximately 80 pounds.
2. Dimensions of base 23½ by 11½ inches, height 12 inches. Spark plugs, carburetor, and fly-wheel adequately protected. Base flanged for back packing and fitted for pack straps; lifting band provided at the point of balance.

3. The unit will deliver 28–30 Imperial gallons per minute at 200 pounds pressure, 35 gallons per minute at 150 pounds pressure, and 40 gallons per minute at zero pressure.

4. The unit is self priming; can be run with delivery cut off or with open discharge. This is accomplished by the use of a special relief valve which opens as the motor loses speed. A part of the valve mechanism is linked to the throttle, thus providing a control when running against light loads. The throttle may also be operated manually. The unit has no running gas tank; fuel is supplied by an automotive type fuel pump. A small gravity tank, for starting, is included in the fuel system. The unit has no grease cups; the motor is self oiling from the fuel supply. The pump shafts are mounted on ball bearings which require lubrication once a year. These bearings are protected from water and grit.

5. The power head of the unit is made up of a light, two-cycle, water-cooled gasoline motor with a normal operating speed of 4,000 r. p. m. Average loads will allow a speed of approximately 3,500 r. p. m. The motor's horsepower rating at this speed is approximately 7.5. The fuel consumption, following an 85-hour test run at full throttle, averaged slightly less than 1 gallon per hour. Oil is mixed with the gasoline at the rate of ¾ pint to 1 gallon of gasoline.

6. Repairs to major working motors part should not be required under 500 hours running time. Replacement of main running parts when required will aggregate approximately $35. The pumping surfaces are completely replaceable for less than $15. Because of the design of the pump, pumping surfaces do not touch, so that wear is almost entirely dependent upon the sand content of the water. All pumping surfaces are of rust-resistant material.

Once properly set up and started, the unit should require no attention other than the replenishing of the fuel supply.

SYSTEMATIC GUARD TRAINING BY TELEPHONE

R. F. Cooke

District Ranger, Mount Baker National Forest, U. S. Forest Service

We all know that fire-guard inspection on the ground can be supplemented effectively by use of the telephone. But knowing the large potential value of the telephone for inspection, supervision, and maintenance of zest is one thing, while making actual use of it for those purposes is quite something else. Here is one busy forest executive who has an interesting accomplishment to report.

The telephone has been used incidentally in training guards on the Mount Baker National Forest for several years, and the last 2 years its use has been on a planned basis. The results are gratifying. It is our observation that although telephone training does not replace personal contact training and inspection, it reduces considerably the amount of time needed for field contacts.

Under a planned system of telephone training, a fake fire report is required from each lookout once a week. The location of the supposed fire is platted by the protective assistant, and any items in the report that do not check with the platting are called to the lookout's attention. Usually he is told only that he has made a mistake and asked to find and correct it. If he finds the mistake himself, he is more likely to remember and not make it again. The report is next platted on the lookout panoramic photograph, and the protective assistant calls the lookout's attention to any additional local landmarks that show up in the picture (a strong reading glass is useful in studying the picture and picking out landmarks).

In using CCC enrollees as emergency lookouts, it is often necessary to detail a man who has had some training but is unfamiliar with the country. These men can be given a good working knowledge of the area they observe by platting the location of streams, lakes, ridges, etc., on the panoramic photographs and giving them the names, azimuths, and vertical angles over the telephone. They can then shoot the points with the fire finder and spot them on the map. Personal inspection has shown that this system enables the men to acquire a good working knowledge of their territory.

Every 2 weeks the protective assistant makes up a list of 20 to 25 questions, using the guard handbook and lookout manual as references, and telephones them to all the fire guards. These questions are worded for a "yes" or "no" answer as much as possible. Starting about 2 days later the protective assistant calls each guard separately and takes his answers to the questions. They should all be correct as the men have their handbooks and manuals for reference. In this way the ranger can be sure that the handbooks and manuals are read and correctly interpreted. Following are a few sample questions:

1. Would a dirty sack on the wet bulb of the psychrometer cause an erroneous humidity reading?
2. What is the correction factor used when orienting one fire finder with another?
3. What would be the correction by the above factor if the lookouts were 20 miles apart true north and south of each other?
4. Is it permissible to use equipment from your fire-chaser outfit around your lookout station?
5. Is section 36 in the northeast corner of a township?

A fourth step in this telephone training: Once a month each guard is asked to make up a list of 10 or more questions on any points of his job on which he desires more information. These questions are telephoned to the protective assistant in a session with all guards on the line, and as each question is read by the man giving it, the protective assistant asks another guard to answer it. If no other guard can answer the question, the protective assistant answers it or refers it to the district ranger. I consider this one of the most important steps, as it clears up many things for the guards. It also trains the protective assistant, and often the district ranger, because frequently points are brought up that he never thought of in making presuppression plans.

In addition to the schedule as outlined, individual problems are given the guards at odd times for them to work out: To recreation or administrative guards, hypothetical problems of law enforcement or public contacts or whatever their line of work may be; for firemen, problems in chasing, what route they would take to reach a fire in a given location, what they would do under certain given conditions on a small fire; for lookouts, calculation of fire size from fire-finder readings, routing of men to a fire in a given location; for the more experienced guards, problems in dispatching, calculation of man power needed for a given size fire in a given location under certain conditions, and action in unusual circumstances. Following are some problems that have been used:

1. A small party of visitors stops at your station and asks you the route to Mount Shuksan. They say they have never climbed a mountain before and their clothes and equipment look unsuited for mountain climbing. State what action, if any, you would take in these circumstances.

2. The rate of travel on this district is 25 miles per hour on roads, 2 miles per hour on trails, and 1 mile per hour across country. A fire is reported in sec. 11, T. 40 N., R. 10 E., and fire fighters have to come from Glacier Ranger Station. How long will it take them to reach the fire? By what route of travel would you send them?

3. A small fire is 33 feet wide on the north side, 330 feet long on the east and west sides, and 66 feet wide on the south side. What is the area in acres and how did you arrive at the answer?

4. You are acting as dispatcher and there are three small fires reported at the same time, in green timber, one each in secs. 1, 24, 31, T. 39 N., R. 8 E. You have available to send at once three CCC men, inexperienced, and three regular trail men who are experienced fire fighters. What men would you send to each fire? Would your action be any different or would you take any further action if the fire in section 1 was in an old burn with many snags?

To my mind the telephone is one of the best devices in guard training if put to its fullest use. A trip to a remote lookout may take 2 days' travel for a few hours' training; whereas, if you have 15 minutes to spare, you can be in contact with the man by telephone in a few seconds. With the telephone 99 percent of the available time may be spent in training; whereas, in a trip to the station 80 percent of the time may be spent in travel and only 20 percent in actual training. Trips to the guard's station should not be abandoned, however, as these contacts stimulate the guard and make him feel that he isn't a forgotten point on the map not important enough for a visit from the ranger. Also, it is not possible to see over a telephone a disorderly station or a poorly kept fire cache, or vice versa, for criticism or compliment.

A CHECK ON FIRE PREVENTION METHODS

G. L. Fraser

Fire Protection Officer, Region 5, U. S. Forest Service

The author is a specialist in charge of fire-law enforcement in Region 5, where experience has shown that heavy emphasis on fire-law enforcement is vital. The effect of such aggressive enforcement needs to be analyzed and measured in every possible way. In no other way can we determine how much of the good of fire-law enforcement is nullified by the ill will and harm which it may engender. The effects of aggressive fire-law enforcement everywhere might well be checked by the methods outlined by the author. Where weak law enforcement prevails, comparable checks to determine the wisdom of that policy should be equally valuable.

Lighting, maintaining, or using a campfire upon any brush, grass, or forest-covered land which is the property of another between April 15 and December 1 of any year without first obtaining a written permit from the owner, lessee, or agent thereof is comparable to hunting without a license in California.

Our fire trespass regulations with respect to the control of campfires are quite adequately supplemented by section 384 of the California Penal Code, which specifically requires a written permit either from the owner of the land or from the Forest Service before camp or other fires may be legally started or maintained on areas as defined.

The Forest Service permits are issued free, and require the signature of the applicant agreeing to the certain provisions with respect to the building of campfires, careful use of tobacco in the woods, carrying of shovel and ax, etc. Special circular instructions provide that forest officers or other issuing agencies must require permittees to read the conditions set forth thereon before signing and accepting the permit.

During the 1937 fire season approximately 400 minor fire cases were initiated for prosecution in the State courts. A large proportion of the cases so initiated resulted from violations of the campfire permit provisions.

After the close of the fire season, a representative sample of the people who had been cited for these minor infractions of the fire laws were interviewed at their homes for the purpose of learning, if possible, just what their general and specific reactions were to the prevention methods applied. Much to our satisfaction we learned that in almost every instance the people interviewed were, notwithstanding the penalties assessed, in sympathy with and cognizant of the necessity for strict regulations in connection with the proper and careful handling of campfires designed to prevent disastrous and destructive forest fires.

The most specific unfavorable reactions seemed to center around what in some instances were termed excessive fines for first unintentional offenses. In some cases these fines ran as high as $25 which, when deducted from vacation allotments, necessitated the curtailment of full time vacation periods.

In most instances where fines of $10 or less were imposed, the principal complaints were to the effect that had the violators known it was unlawful to leave a campfire smouldering while fishing, boating, or hiking for short periods, the violations would not have occurred. This, of course, can be attributed to carelessness from two sources, coupled with possible lack of candor on the part of the permittee:

1. Either the forest officer or other agency issuing the campfire permit neglected to follow instructions requiring the permittee to read the conditions thereon before signing and accepting the permit, thereby overlooking one of the most effective prevention measures within our reach.
2. The permittee was not entirely honest in claiming that he had not read or been required to read the permit before affixing his signature.

The remedy for the first source of carelessness can, of course, be found in the performance record of our own people; while in the second, when we can be reasonably sure that the permittee is not entirely honest, we should have no hesitancy in enforcing the restrictive measures provided.

In all instances, we were advised that the forest officers who visited the camps on their daily patrol or inspection trips were friendly and courteous in every respect, but in many cases it was brought out that they failed to stress the importance of compliance with the provisions of the permits or to inquire if the permittee was thoroughly familiar with the terms thereof. Here, again, if this is true, splendid opportunities for effective prevention work are being dissipated.

Steps are being taken in our prevention campaigns to get the most out of the lessons learned and to benefit from what the violators reported.

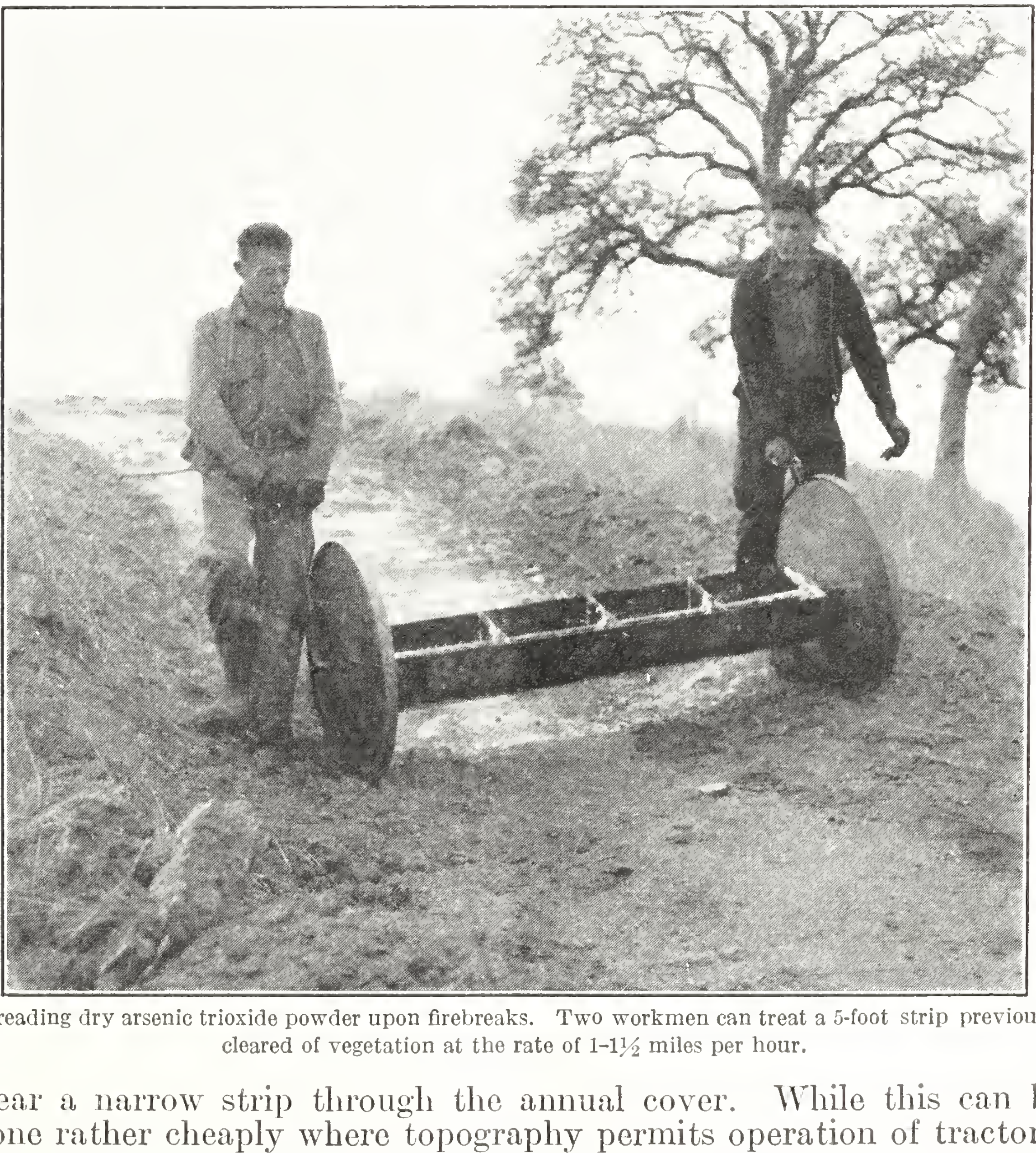
STERILIZING SOIL WITH CHEMICALS FOR FIREBREAK MAINTENANCE

H. D. Bruce

Chemist, California Forest and Range Experiment Station, U. S. Forest Service

It is a common belief that chemistry could be drawn upon for important aid to fire control. Experiments starting in 1911, however, have failed to realize very fully on the apparent possibilities of such aid, but in this article there is presented one important and promising development.

A firebreak, after being cleared of trees and brush, soon reseeds to annual vegetation. Although this does not entirely destroy the usefulness of the break, it does reduce its value for quick and strategic backfiring. For this purpose it has become the practice each year to clear a narrow strip through the annual cover. While this can be done rather cheaply where topography permits operation of tractors, on steep breaks expensive hand labor is necessary. In any case, such clearing is only of temporary value and preliminary work must usually be done before breaks can be fired.



Spreading dry arsenic trioxide powder upon firebreaks. Two workmen can treat a 5-foot strip previously cleared of vegetation at the rate of 1-1½ miles per hour.

Investigations of the possibility of increasing the permanence of backfiring strips by sterilizing the soil have been conducted for several years. Although the effects of a number of industrial chemicals, in various concentrations on various species were studied, only a few were sufficiently effective and at the same time inexpensive enough to warrant their use. Of these, inorganic arsenic is superior. It is relatively cheap, readily available, and extremely toxic.

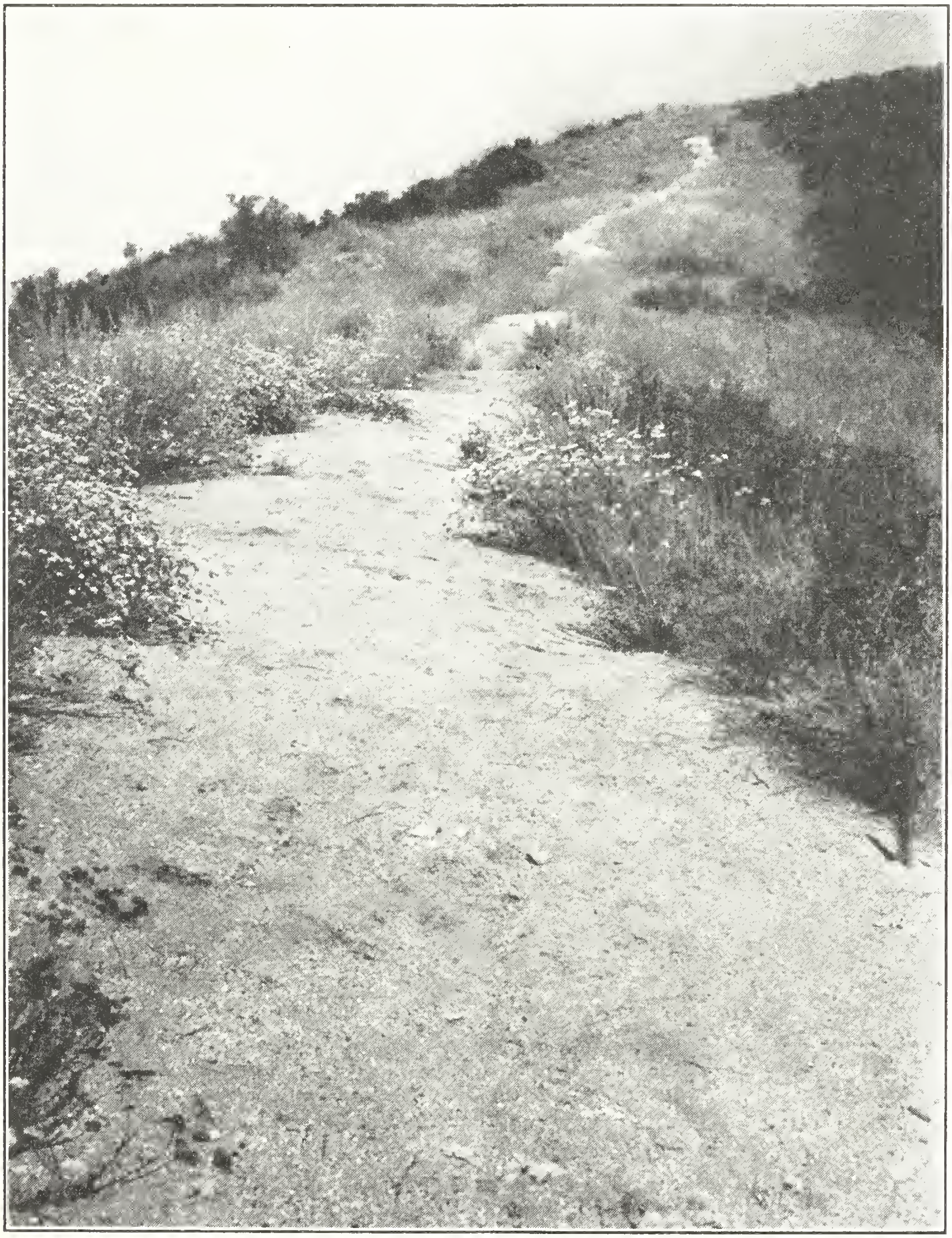
Arsenite has the remarkable property of becoming almost insoluble in the soil. Even though it be applied in the form of a solution, once it strikes the ground it is absorbed by the soil colloids so that it seldom reaches deeper than the first inch or two. It is, however, available for imbibition by roots. Shallow roots of grasses and herbs are thus killed and sprouting seeds never develop.

The 5-foot trail of white arsenic left by the applicator. The trail will remain white until the first rain.

Arsenic is preferably applied in the form of white arsenic trioxide As_2O_3. To spread this as a dry powder, a mechanical applicator has been constructed. It consists of a hopper on wheels, of capacity ample to accommodate 100 pounds of white arsenic. Inside the hopper is a brush, 5 feet long, which rotates as the machine is drawn along, evenly distributing the powder through perforations in the bottom. With this machine, several miles of trail can be treated daily.

For adequate sterilization in the sandy soils of the Sierra Nevada, the optimum spreading rate is about 4 pounds of arsenic trioxide per square rod of surface area. For heavier soils and heavier rainfall, this rate should undoubtedly be increased.

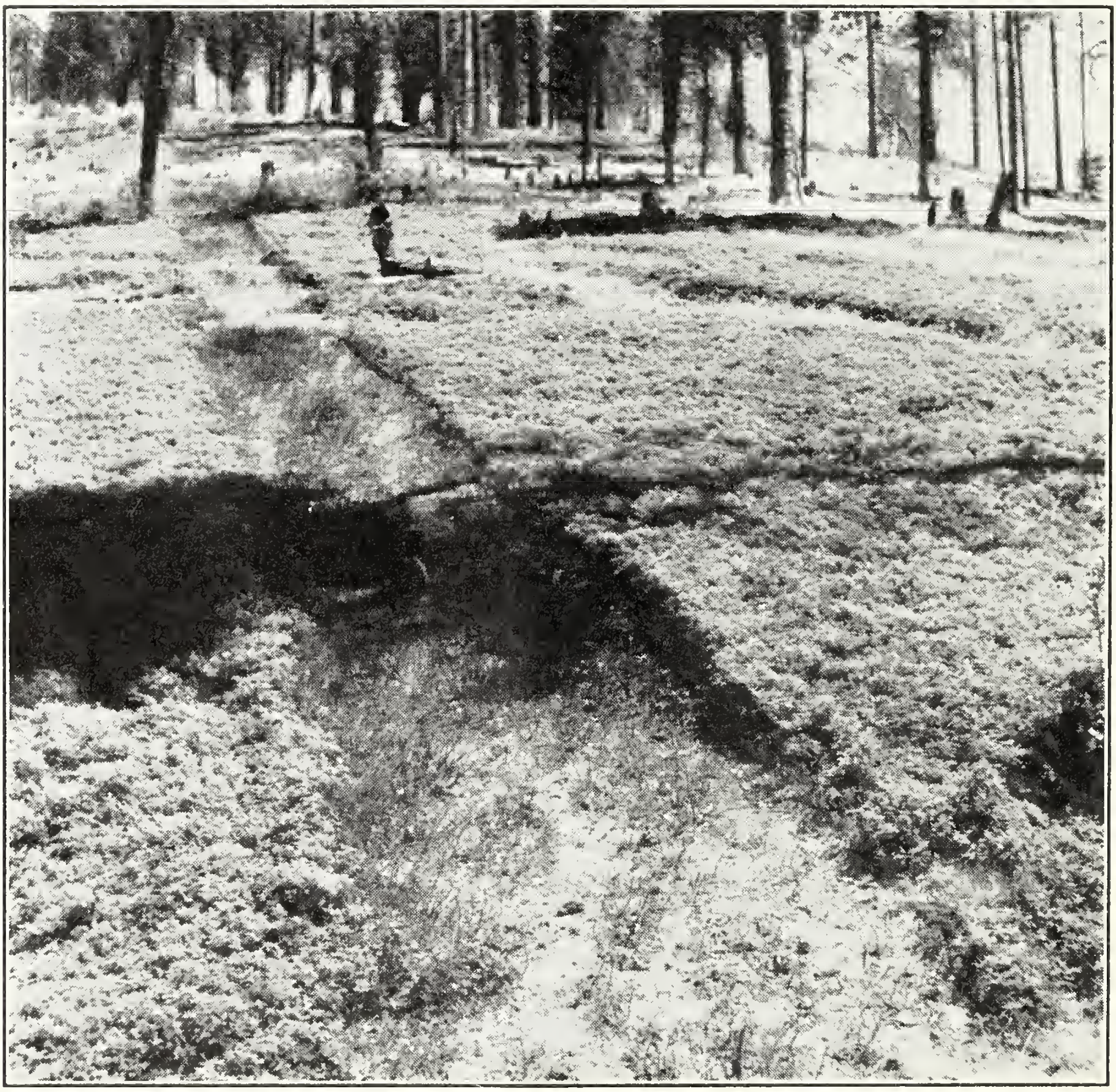
A trail of white arsenic is left in the wake of the applicator. If no maintenance be done on this break in succeeding years, the white trail becomes a bare mineral pathway with dense grass and brush on either side.



A firebreak trail, sterilized with 4 pounds of white arsenic per square rod. still barren after 3 years.

Arsenic trioxide is only slightly and slowly soluble; hence, it is slow acting. It will not kill grass established at the time of application; therefore, it should be in the soil before the seeds begin to sprout. For this reason the apparent effectiveness of arsenic trioxide as an herbicide is often not as great the first summer as it is the second and succeeding seasons.

Arsenic in its surface-sorbed state will not ordinarily kill deep-rooted perennial species. These should be removed prior to the arsenic treatment. If they cannot be satisfactorily uprooted, as is the case with a sprouting shrub like bear clover, chemicals may be profitably used. Sodium chlorate is excellent for this purpose. Unlike arsenite, chlorate remains soluble in the ground and easily leaches down to the level of deep roots. Sprinkled dry or dissolved, at the rate of 4 pounds per square rod, sodium chlorate in one application will penetrate the roots and kill all the bear clover in the treated area. The first rains completely remove this chemical from the top soil layer, in which seeds may again sprout, and grass and herbs flourish. Accordingly, to reduce the soil of a stand of bear clover to complete barrenness, both chlorate and arsenite would be used, the former to kill the bear clover, the latter to inhibit the growth of annuals.



A backfiring trail through bear clover, treated with sodium chlorate and arsenic trioxide, still, quite barren after the third year.

A 5-foot backfiring trail through a dense stand of bear clover was treated with 4 pounds of sodium chlorate plus 4 pounds of arsenic trioxide per square rod. Now 3 years after treatment there is neither bear clover nor grass on the treated ground.

The economic value of soil sterilization depends upon its period of effectiveness. Just how long vegetation will be kept from growing on soil treated with 4 pounds of arsenic trioxide per square rod cannot be definitely stated. It depends largely on chance factors, such as wind and water erosion, treading by horses, cattle, and men, and burrowing by ground squirrels, as well as chemical fixation in the soil and leaching by rain water. In light sandy soils the effective period is longer than in heavy loams and clays. Small fenced experimental plots over 5 years old are still sterile. Having lasted 5 years, the sterilization may last 10.

Although the prime purpose of sterilizing soil on firebreaks is the establishment of a backfiring line, another purpose is cheap firebreak maintenance. To distribute 4,000 pounds of arsenic over 1 mile of 50-foot break by hand labor would cost about $170 for men and materials. Assuming a 10-year duration, this means about $17 maintenance cost per year per mile of 50-foot break. This may be compared with maintenance costs in southern California variously estimated at from $120 to $275 per mile.

On some firebreaks, backfiring trails are cut annually with a disc harrow, the cost of which is about $8 per mile. To spread arsenic on the harrowed trail would cost an additional $15. But, if the $23 thus expended would last 10 years, the annual maintenance cost would approximate only $2.30.

It is generally acknowledged that, under some conditions, firebreaks form an essential part of forest-fire-control facilities. In many cases their strategic use can be increased and their cost of maintenance can be diminished by rational use of soil-sterilizing chemicals.

Arsenic is better recognized as a poison to animals than to plants. If animals eat enough arsenic, they die; if arsenic is spread upon grass which is later consumed by cattle or deer, fatalities may result. However, in our use of this poison on firebreaks, the cover is first removed, then the poison is spread on mineral soil. White arsenic is an oxide with little, if any, taste or odor. In these respects it differs from the sodium arsenite which has a salty taste or sodalike odor and which has proved attractive and disastrous to grazing animals. White arsenic has been applied in cow pastures and deer refuges without the animals showing any signs of curiosity or ill effects.

Men working with arsenic powder must avoid breathing its dust and after each working period should clean carefully beneath the fingernails and wash all dust from the hands and face, lest arsenical skin sores develop.

In addition to the poison hazard, there may be other difficulties. One of these is erosion. Removal of the grass cover by burning, rather than by harrowing, scraping, or dragging, the installation of simple erosion dykes, and the studied location of the sterilized trail will do much to lessen the danger of erosion. Other difficulties are wind and runoff. If a strong wind or torrential rain occurs soon after distribution of the arsenic powder, it may be washed or blown away before becoming fixed in the soil. As a precautionary measure, spraying the treated strip with water following the application of the arsenic powder may sometimes be desirable.

TRACTOR USE IN FIRE SUPPRESSION

P. D. Hanson

Fire Control Planning, Region 5, U. S. Forest Service

All our fire-control machines and tools are in ceaseless competition with each other. One such competition is between the tractor-trailbuilder and the tractor-brushbuster. Region 5 adheres to the tractor-trailbuilder, and year by year makes increasing use of this machine. Region 6 uses the tractor-trailbuilder extensively, but, in addition, has developed the tractor-brushbuster, which is designed primarily for clearing brush, young growth, and debris rather than for digging a fire line to mineral soil. Whether both machines will find a permanent place in fire control or whether one will give way to the other remains to be decided by competitive test and experience. The author reports 1937 progress made with the tractor-trailbuilder in his region.

Tractors were first used in fire-line construction in Region 5 in 1926, when machines of the 60 hp. caterpillar type were used to drag churn-butted logs or graders around the perimeter of the fire. In 1931, the development of the trailbuilder attachment resulted in a complete line constructing unit in itself and eliminated the need for using logs, drags, or graders. This attachment on lighter weight machines also helped to solve the transportation problem, as these lighter units could be readily moved about by truck.

Since 1931, there has been a gradual increase in tractor use in fire-line construction on several of the forests in Region 5. In 1936, the Shasta Forest alone built 38.7 miles of fire line, or an average of 4.3 miles on each of the 9 fires on which tractors were used that year.

In 1937, the region felt it was advisable to make available tractor units with trailbuilder attachments solely for fire suppression purposes. Accordingly, 13 units, consisting of 3 Cletrac 55's, 6 Cletrac 35's, and 4 Caterpillar R–5's, with suitable transportation facilities, were stationed at strategic points throughout the region and held in readiness for fire call. One of the Cletrac 35's was equipped with a water tank of 140 gallons capacity, water pump, and hose. These 13 tractors were made available for the period June 1 to October 30, at a total rental cost for tractors and trucks of $4,400.

In addition to the tractors provided solely for fire-suppression purposes, other machines, some of which were rented from private operators and others which were operating on Forest Service improvement projects, were used for constructing fire lines in suppression during the season.

The 1937 fire season was noted for its relatively low percentage of class C fires. Only 73 out of a total of 1,505 fires, or 4.8 percent, were 10 acres in area or over. Consequently, tractors were not called into use to the extent that they would have been in previous seasons had they been available. However, they were used on a sufficient number of fires to warrant a study of their effectiveness and cost.

In addition to their use on actual fire-line construction, these tractors also contributed materially to other fire-suppression activities, some of which were:

Reenforcing and widening hand-made corral lines.
Assisting in mop-up, which included pulling down and removing snags, pushing in burning chunks, ditching, digging out burning stumps, etc.

Opening up and building roads to enable camps to be established nearer the fire or to provide transportation of men by truck nearer to the fire line.

Hauling water on sleds to the fire to supply back pumps.

Opening up or building roads to and around the fire to enable water-tank trucks to reach the fire line and assist in control and mop-up.

Since there was a marked difference in the cost of maintaining tractors for fire use only, compared to the cost of utilizing other machines for suppression work, the accomplishments and costs of each class have been kept separate. Table I shows the use to which the tractors were put and the production in chains per hour, cost, estimates of man hours required to duplicate the work, and other related data.

Table I

Description of tractor use	Private and improvement tractors	Fire stand-by tractors	Total all tractors
1. Number of fires on which tractors were used	12	8	20
2. Total fire perimeters (chains)	2,927	1,978	4,905
3. Fire line constructed by tractors (chains)	727	827	1,554
4. Percentage of total fire line worked by tractor	24.8	41.8	31.7
5. Time to construct fire line (tractor hours)	77.8	92.5	170.3
6. Rate of construction per tractor hour (chains)	9.3	8.9	9.1
7. Cost per tractor unit hour. (All costs including labor and rental prorated against actual working time for season)	$13.22	$35.60	$22.90
8. Cost per chain of fire line constructed	$1.41	$3.99	$2.51
9. Estimates of manpower equivalent chains per man hour (considered optimistic)	.21	.66	.32
10. Estimates of manpower saved (man hours)	11,490	5,770	17,260
11. Number of men equivalent to one tractor unit in line construction	45	14	29
12. Conservative estimates additional burned area prevented (acres)	1,135	1,155	2,290
13. Fire line used as roads. Permitting tank truck mop-up (chains)	156	191	347
14. Other roads constructed (chains)	425	10	435
15. Time to construct these roads (tractor hours)	55	2	57
16. Used other activities (tractor hours)	37	35	72
17. Average number of men in tractor crew	3.2	2.8	3.1

From general descriptions of the fuels in which fire line was constructed, the season's experience indicates what may be expected in line production by machines of different sizes in the resistance-to-control fuel classes as follows:

The larger tractors, such as the Caterpillar RD-8 and RD-7 and the Allis-Chalmers 75, showed a range in line production from 7 chains per hour in extreme resistance fuels to 35 chains per hour in the moderate resistance fuels.

The medium sized tractors, represented chiefly by the Cletrac 55, produced line at the rate of 11 chains per hour in the high resistance fuels and 30 chains per hour in fuels of moderate resistance.

The Cletrac 35 produced line at the rate of 4 chains per hour average in the high resistance fuels and 10 chains per hour in fuels of moderate resistance.

The small Cletrac 15 produced 65 chains of line in low resistance fuels at the rate of 130 chains per hour.

The figures appear to indicate that the larger machines are the more effective in line construction, and appear to contribute more as the resistance class becomes more difficult, if they can be placed on the fire line. The main obstacles to their use are transportation and bridge limits.

Since the degree of slope is an important factor in the effectiveness of tractors in fire-line construction, an effort was made to collect information on the maximum practical limits in slope which various machines can negotiate effectively. Information secured on the Caterpillar Diesel models is included in the following list:

1. Nearly any standard make of track-laying tractors can negotiate slopes up to 35 percent, terrain and vegetation permitting, and up to this limit can work effectively either up or down the hill, quartering up or down the hill, or working across the slope, or parallel with the contour.
2. Caterpillar D–7 and D–8 will climb up a 45 percent slope. Caterpillar D–6 will climb up a 50 percent slope. Caterpillar D–4 will climb up a 55 percent slope.
3. The element of danger enters rapidly in descending slopes approaching 60 percent and over.
4. The wide gage model machines, with track shoes 2 inches wider than the standard furnished, are recommended.
5. The hill-climbing ability of the Caterpillar D–4 tractor is explained by the fact that this machine has less weight per drawbar horsepower than the other machines mentioned. The use of this machine will be experimented with further.

The economy in use of tractors in fire-line construction alone is evident when one compares the cost range, as shown in table 1, with the average regional cost of line construction by hand, which analysis shows exceeds that of the tractor by 200 to 300 percent. Significant, also, is the rate of line construction and the additional contribution of the machines to the efficiency in execution of many other parts of the fire-suppression job.

The relative economy of and justification for more universal use of other Forest Service improvement and privately owned machines is evident. Lack of suitable transportation is the chief reason which limits this use. There is a justifiable need for at least one large fast truck on each of the fire forests.

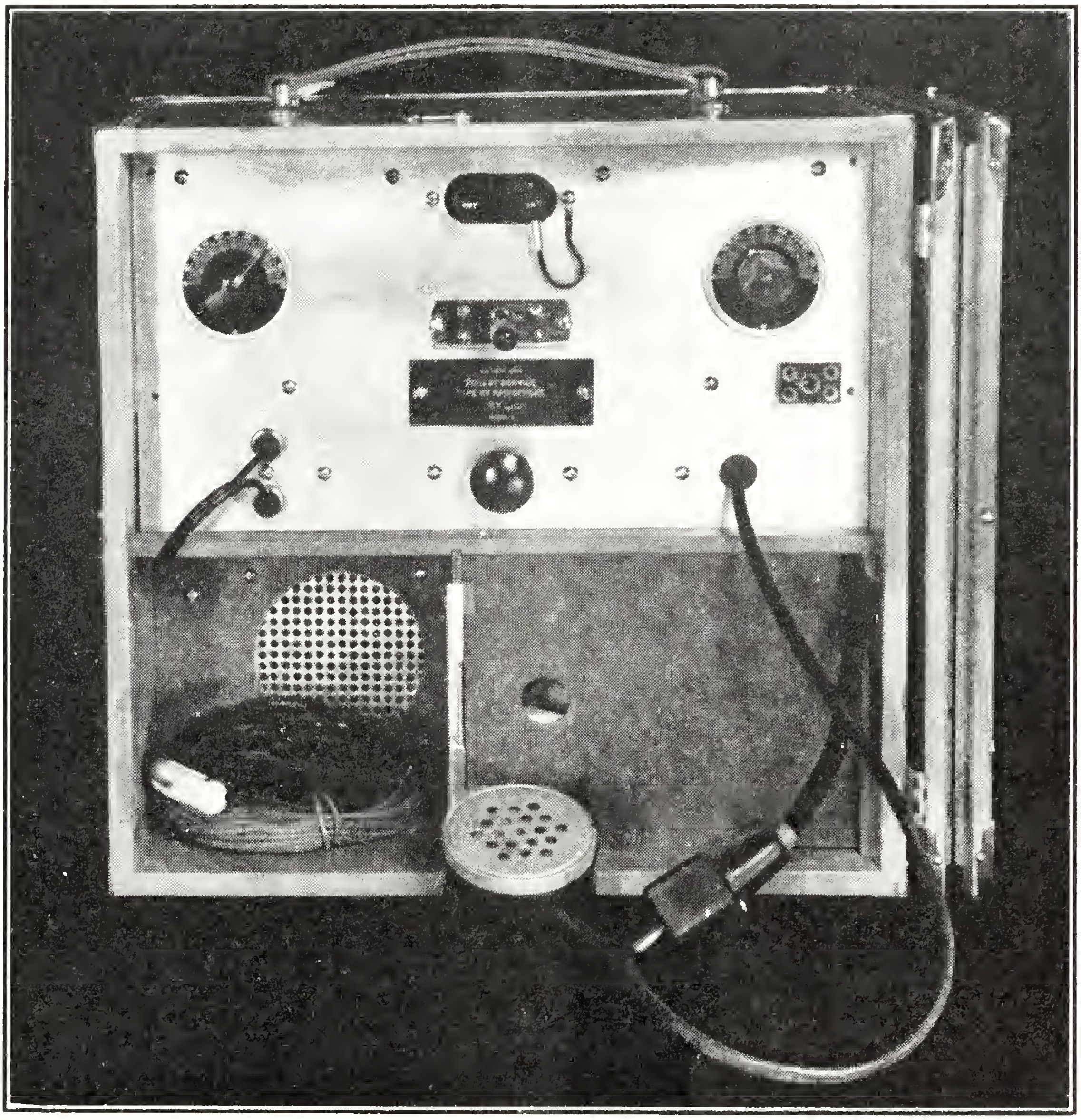
Planning in connection with the use of tractors in fire suppression should be directed toward identification of areas where these machines can be used, and the preparation of maps showing these areas, segregated by slope classes, recognizing the limits between 0 to 35 percent, and 35 to 55 percent. This information, supplemented with maps showing resistance to control-fuel types and the occurrence of C fires, should prove a strong basis for distribution of machines and should be an aid to dispatching action.

RECENT ADDITIONS TO FOREST SERVICE RADIO EQUIPMENT

A. G. Simson

Radio Engineer, Region 6, U. S. Forest Service

Since the various types of Forest Service radio equipment were described in Mr. Simson's article, "Forest Service Radiophone Equipment," page 197, Fire Control Notes, April 1937, two new pieces of apparatus have been developed. The new radiophones are described in this article. Requisitions for Forest Service radio equipment and correspondence on technical matters should be addressed to: Regional Forester, Box 4137, Portland, Oreg.



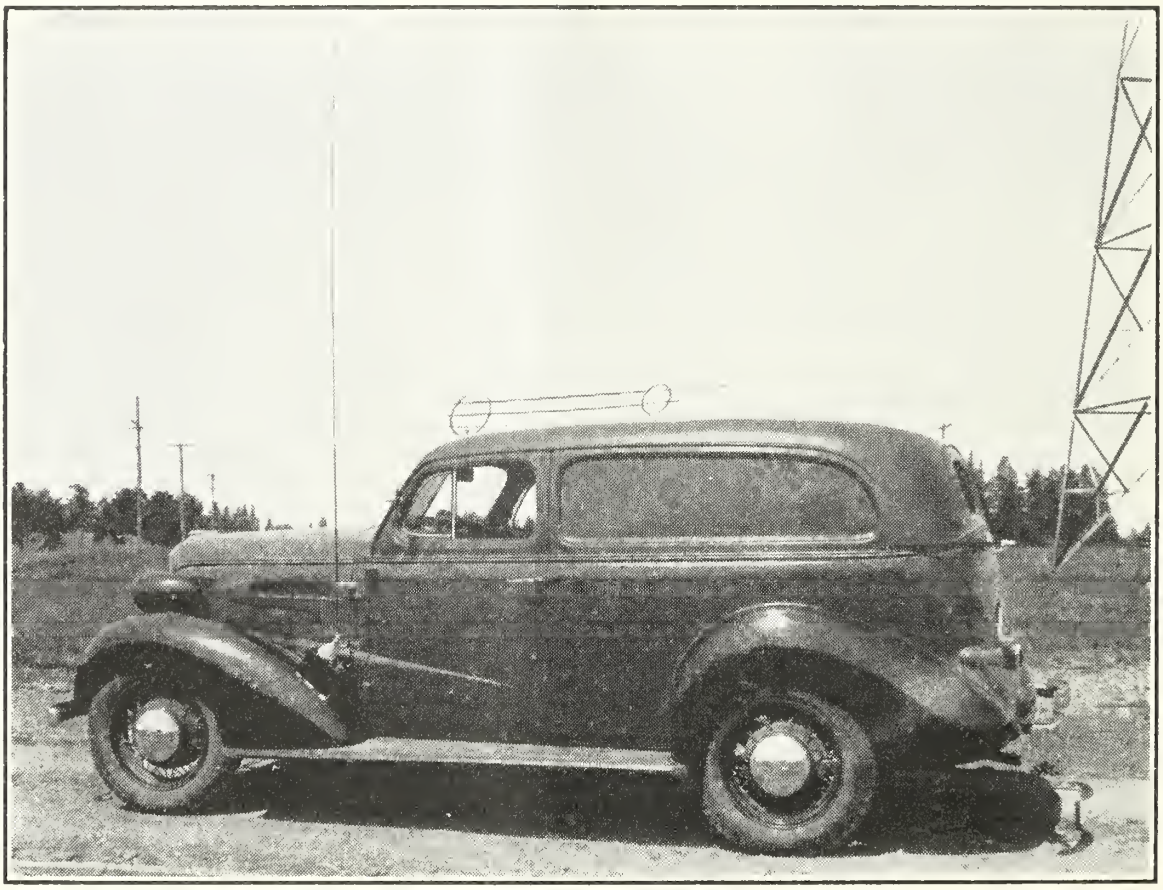
Type SV ultra-high frequency radiophone.

Type SV Radiophone (UHF)

The type SV radiophone is a larger and more powerful adaptation of the type S radiophone. Where the additional weight and bulk do not preclude its use and the extra cost can be borne, it offers several marked advantages over the type S.

The type SV transmits and receives voice only, and is intermediate in power between the types S and T. The estimated working range may vary from 80 miles between mountain lookouts to as little as 3 or 4 miles under certain level-ground conditions. Independent transmitting and receiving sections are mounted on the same chassis, which completely eliminates the frequency shifting between transmit and receive which is necessary in type S. A loudspeaker only is provided on the receiver. The same antenna is used for both transmitting and receiving. A special method of coupling permits a wide variation in the types of antennae employed.

For medium duty or intermittent service all batteries are contained in the set cabinet. Heavy-duty batteries for continuous operation may be attached externally by means of a special cable, which, however, must be ordered as an accessory item. Weight, complete with medium duty batteries, 18½ pounds.



Mobile antenna installation showing method of mounting.

Type I Radiophone

The type I radiophone is a condensed and simplified unit intended for operation on 6-volt storage battery only, and transmits either voice or cw telegraphy. The power output of the I-type transmitter is intermediate between that of the types SPF and M. Normal output power is approximately 9½ watts.

This device is supplied in individual units—receiver, transmitter, and transmitter power supply. For semiportable operation these units are grouped into a single mounting cabinet.

Type I is primarily designed for mobile installation in cars or trucks, and the various units may be distributed under the dash or in other locations to take advantage of available space. For mobile operation the receiver supplied with the type I is similar in appearance to a conventional automobile radio receiver. It is equipped with a very satisfactory system of push button tuning which may be mounted near the steering column of the vehicle.

When ordering the type I, specify whether for semiportable or mobile installation. If for mobile use, give make and year of car so that a suitable receiver tuning head may be supplied. When supplied for mobile operation a special rod-type antenna will be furnished with the necessary tuning box for mounting on fender or bumper of car. The type I will be supplied to transmit and receive voice only when ordered for mobile service.

The range of the mobile radiophone varies from an estimated 25 miles under unfavorable conditions to as much as several hundred miles under favorable conditions. Probably the range is comparable to that of a type SPF radiophone using kitbag batteries and antenna.

EMERGENCY WIRE REEL

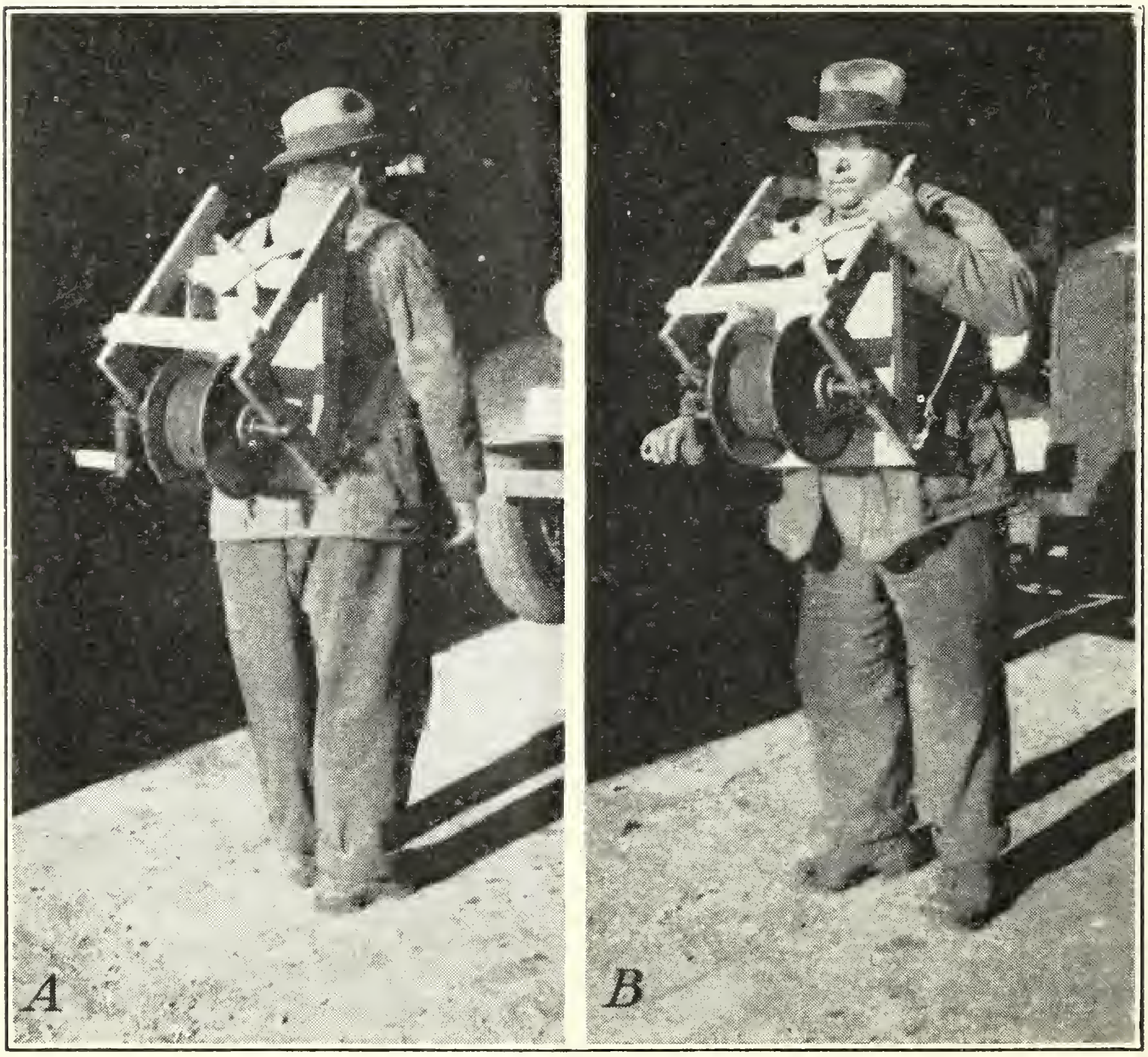
JACK GILMAN

District ranger, Lassen National Forest, U. S. Forest Service

In order to pay out and take up emergency wire without breaking or wearing it out, a reel was constructed back in 1933, which has since been used successfully on numerous fires. One man can reel out or reel in the wire as fast as he can walk.

When paying out wire, the reel is worn on the back, the loose end is secured, and the man simply walks to his destination reeling out the wire as he goes. When taking up the wire, the reel is worn on the chest or stomach, the man travels toward the other end of the wire turning the crank and reeling up the wire as he walks. The wire is not dragged in either operation.

The unit which holds the spool consists of ¾-inch pipe, 90° elbow, and wooden handle. To the shaft are welded three washers, two to prevent side play in the frame and one to support one end of the spool. The spool of wire is placed on the shaft out of the frame. The end of the pipe is threaded to take a ¾-inch floor flange which is used as a lock nut to keep the spool from turning on the shaft.



Emergency wire reel in use: (*a*) Back view, (*b*) front view.

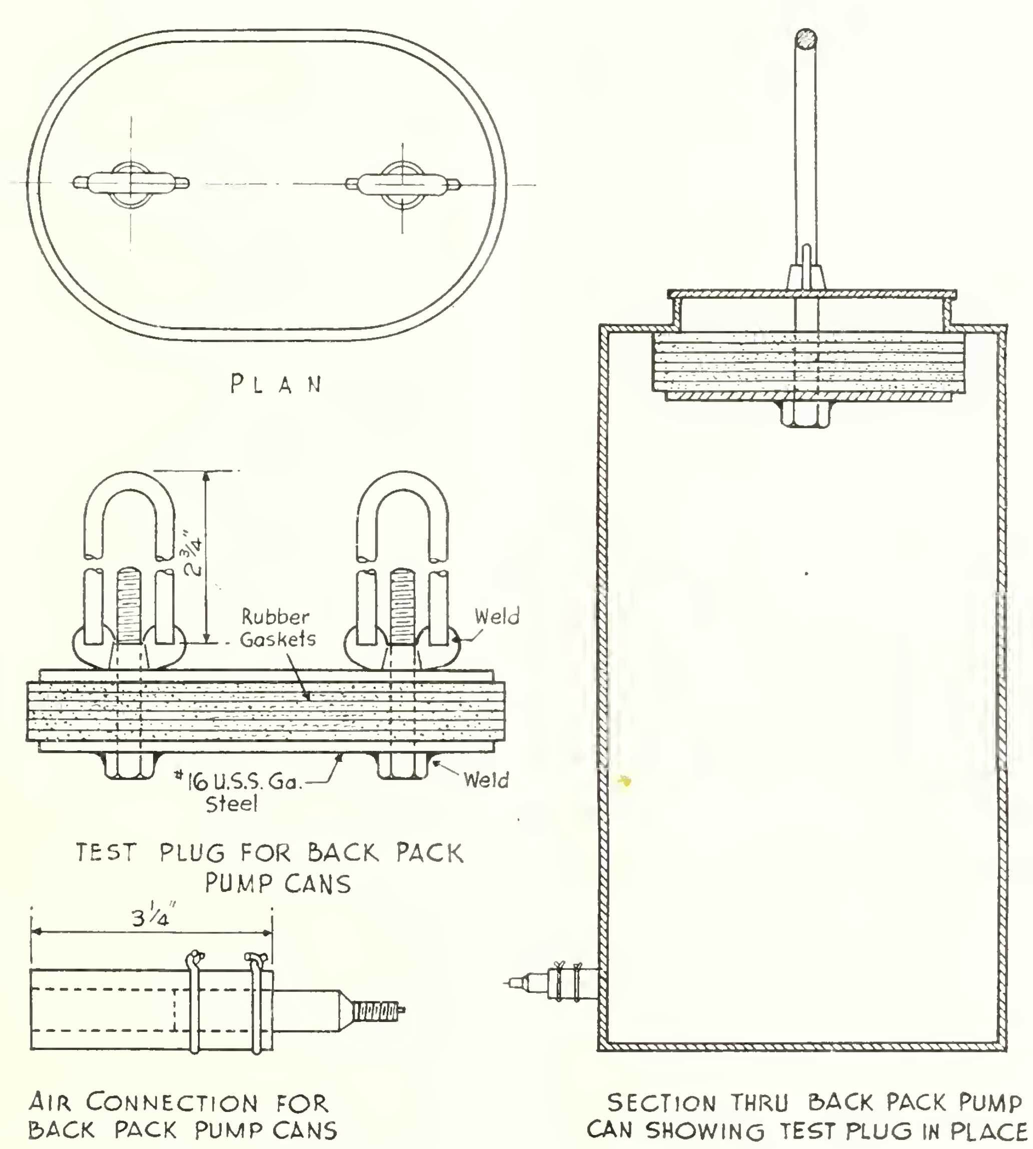
The shaft unit is supported by a wooden A frame attached to a pack board with straps. In one side of the frame there is a hole into which the threaded end of the shaft is placed, and a slot on the other side for the shaft to be secured in place by a pin and iron straps similar to a barrel lock.

TESTING BACK-PACK CANS FOR LEAKS

FOREST PROTECTION DIVISION

Wisconsin Conservation Department

A valve for making the top of the can air tight, and an air valve, such as an auto tire valve, which may be inserted in the can and attached to an ordinary air hose for testing purposes, are the essential items needed in order to test back-pack cans for leaks. Testing in this way has proved to be very rapid and efficient, particularly where there are large numbers of cans to be overhauled following a large fire or a heavy season's use.



TEST PLUG FOR BACK PACK PUMP CANS

AIR CONNECTION FOR BACK PACK PUMP CANS

SECTION THRU BACK PACK PUMP CAN SHOWING TEST PLUG IN PLACE

Note: Length and width of steel plates to be cut ½" larger and rubber gaskets ⅝" larger than opening of pump cans. Two (2)-5/16" bolts of sufficient length shall be welded to bottom steel plate. Top and bottom plates to be made up from #16 U.S.S Ga. Sheet steel. Rubber gaskets to be cut from heavy duty inner tube. Two (2) ¼" dia. x 2¾" Lg. Iron "U's" to be welded to wing nuts.

Air connection for Back Pack Pump Can to be made up from inner tube valve stem with shoulder removed and inserted in ½" I.D. Heavy rubber tubing and tightly wired in place.

Plans of can leakage tester.

HANG-OVER LIGHTNING FIRES

C. D. Blake
*Assistant Forest Supervisor, Flathead National Forest,
U. S. Forest Service*

To those who do not know the job, it is a constant wonder that lookout men get azimuth readings on lightning strikes as well as they do, particularly at night. Even so, the average record lacks completeness and precision. Anything that will make for greater accuracy is, therefore, of high importance. The author suggests a device by which lookout men may get a rough but useful measure of the linear distance to such strikes.

The high percentage of hang-over lightning fires, like an unconquered bugaboo, continues persistently from year to year to smirch our fire-control achievement records with unsightly blots.

The main trouble appears to be our inability to locate accurately fire-setting lightning strikes in order that they may be searched out and squelched without the alarming elapsed discovery time which is so common. Even the experienced observer finds that too often the blinding lightning flash prevents accuracy of location. Camera records convince us that too often the human eye detects only a small percentage of simultaneous strikes to ground. Too often the lightning flashes come too thick and fast to permit even the experienced man to record more than a small percentage of the strikes to ground. If this is the case with the experienced observer, is it any wonder that the (probably badly frightened) inexperienced man fails?

A flash of forked lightning which confused four experienced fire-control men.

I recognize my inability to offer a satisfactory solution to this important problem in fire control. I do know from experience that the old scheme of attempted location of lightning strikes by azimuth triangulations from two or more observation points is very unreliable.

Admittedly, in the following proposed substitute method for lightning-strike location there are possibilities of error because of optical illusions. However, if given a fair trial, I am certain you will discover it has advantages over the old scheme, and may be improved on. At least this plan permits observers to try independently for strike locations. Here it is:

Upon the approach or formation of an electric storm prepare yourself with fire finder or a sight compass. When a lightning strike appears, direct the sights of the instrument on the location and determine the period, in seconds, between the flash and the sound of thunder. Since sound travels a mile in approximately 4.5 seconds, the distance may be determined by dividing the period in seconds by 4.5 or 5.0. (Use 4.5 if wind blows toward you from the strike and 5.0 if it blows away from you.) The strike location may be determined by scaling off on the map the direction and distance. A stop watch is recommended for recording the interval between the flash and the sound of thunder. However, the period may be ascertained in seconds by counting, beginning with 1,001, 1,002, 1,003, etc., then by dividing the last three numerals by 4.5 or 5.0.

REGION 6 FIRE-DANGER BOARD

Donald N. Matthews and J. F. Campbell

U. S. Forest Service, Portland, Oreg.

In each district ranger's office in U. S. Forest Service Region 6 (Washington and Oregon) is a fire-danger board which strikingly summarizes the variable factors of fire danger and combines them into class-of-day ratings. Although a few experimental boards were on trial in 1936 their regular use was started with the 1937 fire season. The fire-danger boards and the rating system were developed by the Pacific Northwest Forest Experiment Station collaborating with the regional fire-control office.

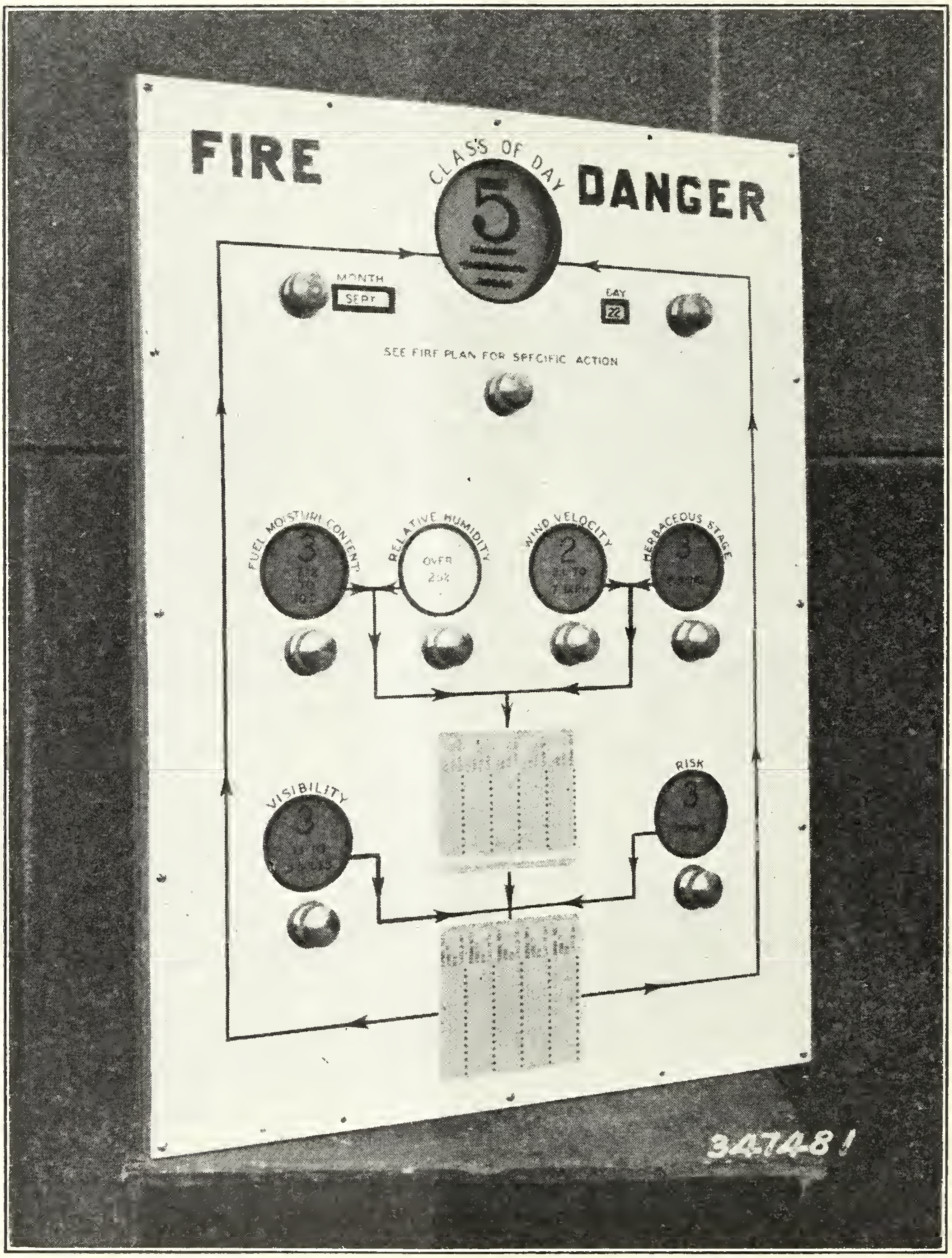


Figure 9.—The Region 6 fire-danger board.

The fire-danger stations are the source of information used in "posting" the boards which the rangers use in determining presuppression action. These are located at guard stations where fuel-moisture-indicator sticks (called "fuel sticks" for short), wind gage, psychrometer, and herbaceous-stage plots are used to measure fuel-moisture content, wind velocity, relative humidity, and herbaceous stage, respectively. In addition, Byram haze meters are used to measure visibility conditions; i. e., radius of vision, from certain selected lookout points. Ocular estimates are made at other points.

The fire-danger boards are 18 by 24 inches in size, made of metal. Each factor of fire danger used on the board is divided into classes, and each class is assigned a color. Fuel-moisture content, as measured by the fuel-moisture-indicator sticks, for example, is represented by classes and colors as follows: Class 4, 0 to 7 percent, red (this is the most dangerous condition); class 3, 7.1 to 10 percent, orange; class 2, 10.1 to 18 percent, blue; class 1, 18.1 to 25 percent, green; and class 0, above 25 percent, white. Corresponding classes of all factors have the same color; that is, class 4 is always represented by red, class 3 by orange, etc. Large class numerals (4, 3, 2, etc.) in black and the color of the current condition of each factor are displayed through an opening in the board by turning a knob attached to a disk mounted behind the face of the board. A glance at the board may show red, 4 (a large black 4 on a bright red background), fuel moisture; red relative humidity; green, 1, wind velocity; red, 4, herbaceous stage; blue, 2, visibility condition; and orange, 3, risk existing on the district.

All these factors are combined, by means of two simple integration tables on the face of the board, to produce one of seven class-of-day ratings. As a final operation the class-of-day numeral (7, 6, 5, 4, etc.) in black on an appropriate colored background is displayed in a large opening at the top of the board by turning another disk.

Fuel-moisture content, relative humidity, wind velocity, and herbaceous stage have a place on the board because they determine how fires will burn.

Fuel-moisture content is measured by means of fuel-moisture-ndicator sticks, used in sets of three. They are one-half by one-half nch ponderosa pine sapwood sticks containing 100 units (grams) of oven-dry wood. Their weight (in grams) indicates their moisture content without any computations. (Simple, low-cost scales have been devised to weigh these sticks.)

The fuel-moisture-indicator sticks are continuously exposed in the open under the same forest-cover conditions as the fuels that are typical of each locality. They indicate the cumulative effect on fuels of the interplay of all weather elements—relative humidity, temperature, wind, rain, etc.

The herbaceous-stage factor is an estimate of the current fire-danger status of the annual growth of vegetation, such as grass, ferns, and weeds, made on plots staked out in representative areas. When the annuals are green and succulent, they do not add to the fire danger, but may be a retardant. As the season passes and they become progressively drier, they add materially to the fire danger. The effect of this vegetation on fires varies greatly at different periods of the fire season and on the same date in different years. The estimates on condition of the herbaceous plots furnish a practical means of weighing this factor in rating current fire danger.

Fuel-moisture content, relative humidity, wind velocity, and herbaceous stage are combined in a single integration table on the face of the board to produce a burning index. This burning index is concerned only with those factors of fire danger which vary markedly during the fire season. For example, although the kind and the quantity of fuel varies from place to place and may be of major importance in determining what a fire will do when burning conditions are dangerous, these factors remain practically constant, except as taken care of in the herbaceous-stage factor on the board, and are not considered among the variable factors combined in the burning index.

Having obtained the burning index from the burning-index table on the board, the next step is to determine the total fire-danger condition in order to decide what action should be taken—how many lookout men, smoke chasers, and patrolmen are needed. In order to get this, visibility conditions (the distance lookout men can be expected to see the smoke from a small fire) and risk (the relative activity of the fire-starting agencies such as man and lightning) also have a place on the board. These two factors of fire danger are combined with the burning index in a second table, and produce one of seven class-of-day ratings that are used to determine the presuppression action that will be taken to meet the fire-danger conditions that produced the rating.

Each district ranger prepares a fire plan at the beginning of the fire season which stipulates in detail the action he will take to meet each class of day. The fire plan is the connecting link between the rating of fire danger and administrative action. Although its striking color scheme makes the board the showy feature, nevertheless the ranger's fire plan is the heart of the system because it gives it life and action. It indicates the specific action the ranger will take to meet each class of danger. For example, his plan will list by name the positions to be manned—lookouts, patrols, etc.—and other action to be taken to cope with each class of day.

The fire plans are localized because they are made for each individual district. They also provide an opportunity to incorporate provisions that action to meet any one class of day may vary somewhat depending on the factor—visibility, risk, etc.—which dominates the situation. Thus somewhat different action may be set up for a class 5 day caused by dry fuels and high winds than for a class 5 day caused by lightning.

The forest supervisor has a special fire-danger board in his office which shows the class of day reported on each ranger district. In the regional forester's fire-control office in Portland there is a master board which shows the class of day on each of the 100 ranger districts in the region. This master board consists of a large map of the region with a colored light at each ranger's headquarters to indicate the class of fire danger on each district.

MISSISSIPPI FIRE TANKS

VICTOR B. MACNAUGHTON

Fire assistant, Mississippi national forests, U. S. Forest Service

When the creative development of power-driven and other tools for fire control finally begins to slow down (if it ever does), it is more than probable that the crawler tractor will be playing an important role. In the October 1938 issue of Fire Control Notes, George M. Gowen reported one development in the use of water in California by means of the tractor. Here is testimony on the same point from a Gulf State.

Just as the thrilling cavalry charge in the military battles of 50 years ago is only a memory in the mechanized warfare of today, so the mass attacks of sheer manpower on fires in south Mississippi seems doomed to be replaced by mobile power units backed by small crews.

Twenty years ago at Ypres, the Hindenberg Line got a terrific shock when out of the misty smoke-filled dawn hundreds of British tanks advanced. Twenty years is a long time and it's a far cry from Ypres to the Leaf River battlefields on the DeSoto National Forest; yet, one afternoon in January, Mechanic "Slim" Sheffield rode into the smoke and flames behind the controls of a modern fire tank. The result on the enemy was comparable to that effected by the British tanks. Over logs, crashing through blackjack thickets, down hills, across swampy flats, always on the trail of the spreading fire line went the fire tank. Spewing a driving spray before it, the tank completely conquered flames 20 feet high backed by a 25 m. p. h. wind. Half a mile of line was conquered before it was necessary to refill the tank. Thus a new era of mechanized fire fighting was begun in Mississippi.

This fire tank solves the problem of direct attack on the head of a large grass fire. Heretofore, when backed by a strong wind, the head of the fire traveled until stopped by a backfire or natural barrier. Fire trucks are available on all national forests in Mississippi, and are very effective when they can be placed on the fire line. Their use, however, is limited by the topography, and usually they cannot reach the point where they are needed most.

This initial Mississippi fire tank was built at the Leaf River depot by Shop Foreman Sheffield, after a series of experiments and trials on actual fires. It does not represent the highest degree of possibilities, but its effectiveness on the fire line completely demonstrates the practical value of such a unit.

This first edition was built around a Cletrac A. G. 20 Tractor, on which are mounted two 100-gallon tanks. A power-driven hydraulic pump from a discarded dump truck drives the water under 100 pounds pressure through sprayers in front. The power take-off was made from discarded auto and tractor parts. The speed of this pump is approximately 1,500 revolutions per minute.

A by-pass valve, which is adjusted to the pressure desired, is built in line between the pump and nozzles. The two tanks are hooked together so that the pump draws evenly from both. A three-way valve, coupled in the suction line, permits the operator to refill the tanks in 12 minutes. The take-off that controls the pump so that it may be shifted in and out of gear is located under the driver's seat.

The spray attachment in front consists of a semicircular length of pipe to which are fitted three sprayers. The unit is mounted with brackets near the top of the radiator and close to it. The bumper provides protection to the sprayer from bushes and trees.

A second spray attachment is located directly under the bumper. The water from these nozzles is directed straight down. This spray has separate controls and may be used or not as the occasion demands.

Twenty-five feet of high pressure hose is attached to the rear of the unit. This hose has a pistol-grip nozzle similar to the one used by automobile washers. If, because of some obstacle, it becomes necessary for the tank to veer off the fire line, that portion of the line can be suppressed by the hose operator walking behind the "tank." This hose is also useful to catch burning snags or logs which need immediate quenching. An extra section of hose is carried in case of emergency.

Transportation for the "tank" is provided by a 2-ton International truck. Upon arrival at the fire, heavy oak skids are pulled out and lowered to the ground. A sawhorse placed under the rear end of the body takes up some of the weight as the "tank" is driven down the skids onto the ground.

Conditions on the DeSoto National Forest in south Mississippi are especially favorable to the use of heavy power equipment. The land is gently rolling, offering no steep slopes to be climbed. Almost completely denuded of its mature timber a decade ago, the small blackjack, oaks, and young pine reproduction are easily ridden down by the fire tank. The light, flashy fuel cover of broomsedge grass yields readily to attack by water. A complete system of fine gravel roads insures fast travel to any fire. A number of these tractor units on each DeSoto district would tend to offset the loss in manpower brought about by the recent abandonment of CCC camps.

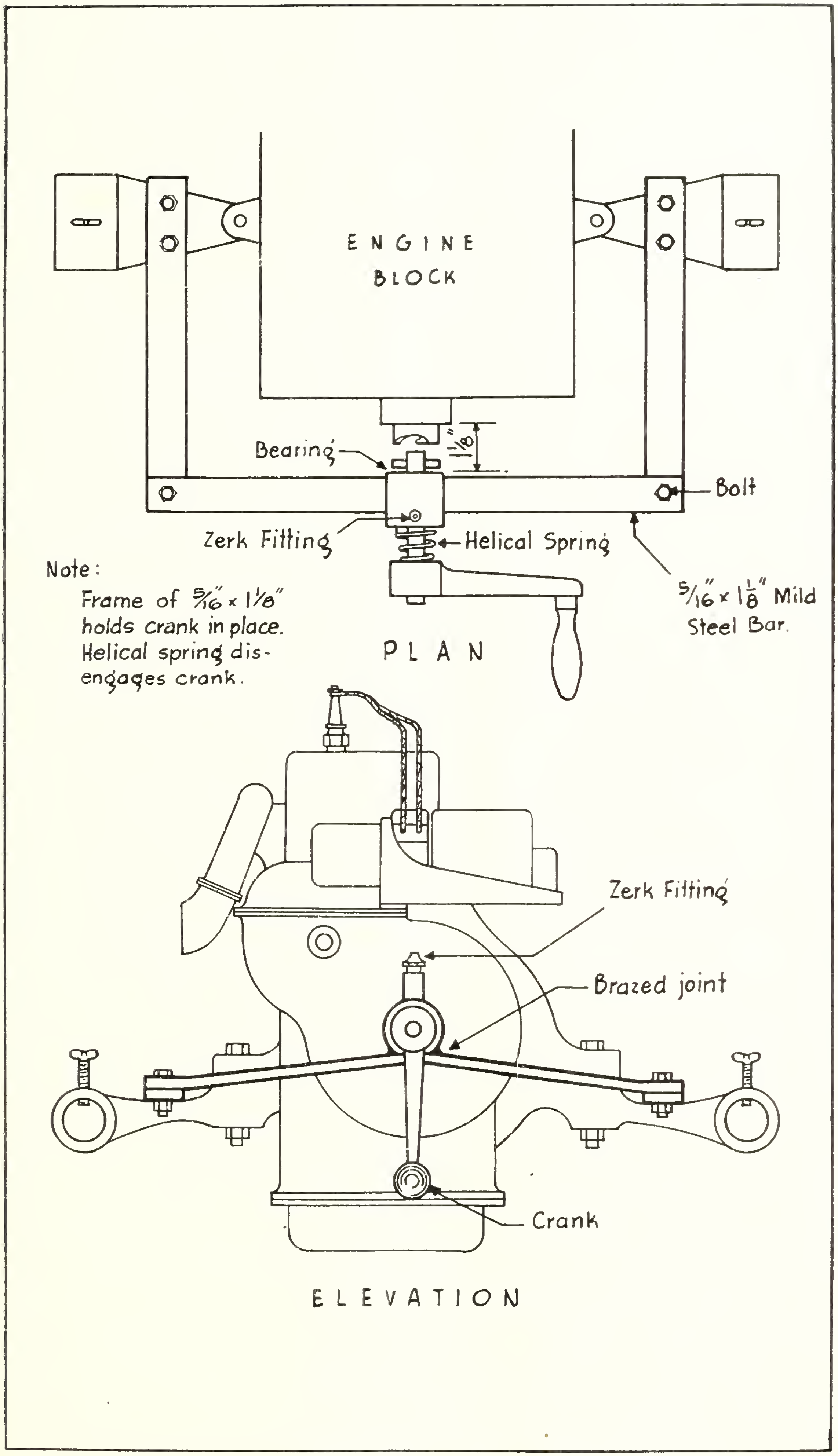
Some improvements planned for future models include more pressure, a more substantial pump, larger water tanks, a starter and lights for the tractor, and the use of mono-ammonium phosphate in the water tanks.

CRANKING DEVICE FOR PACIFIC PUMPER

Chippewa Forest, Region 9, U. S. Forest Service

The device shown in the accompanying sketch was designed for the four-cylinder U-Type Pacific pumper. It makes for easier and safer cranking and keeps the crank always in place.

The frame, made of 5/16 by 1 1/8-inch mild steel bar, is bolted to the front carrier supports, and extends around the front of the engine. The cross bar has a slight bend to line up the crank with the crankshaft rachet. The crank bearing is brazed to the frame and a spiral spring is used to keep the crank disengaged. A fitting may be added to facilitate greasing.


ENGINE BLOCK
Bearing
$1\frac{1}{8}''$
Bolt
Zerk Fitting
Helical Spring
Note:
Frame of $\frac{5}{16}'' \times 1\frac{1}{8}''$ holds crank in place. Helical spring disengages crank.
$\frac{5}{16}'' \times 1\frac{1}{8}''$ Mild Steel Bar.
PLAN
Zerk Fitting
Brazed joint
Crank
ELEVATION

Cranking device for 4-cylinder Pacific pumper.

PRE-SEASON GUARD TRAINING ON THE HEBO DISTRICT

ROBERT AUFDERHEIDE

District Ranger, Siuslaw National Forest, U. S. Forest Service

Any time that two or more fire-control men gather together the topics of training and morale are sure to come up. The national forest replanning project gives high priority to both subjects, but sometimes it is hard to take hold of them effectively. Here is a district ranger who has tried a simple but excellent way of advancing both morale and training.

On February 20, 1937, while I was returning from the Oregon State Fernhopper banquet with four of the short-term force, one of the guards suggested a program of winter guard-training meetings. It was his idea that a weekly meeting, where the boys could discuss a problem or topic, would shorten the winter months as well as enable each man to prepare himself better for his job. As we discussed the idea, we became enthusiastic, and before we arrived home that night we had decided to give the idea a trial.

A week afterward I was attending the spring rangers' training camp so we did not hold our first meeting until my return. By this time our womenfolk had heard of the idea, and they decided they would also have a meeting—purely social. On April 9 we had our first meeting. The women gathered in the ranger dwelling and we met in the office. After a session of an hour or two, we joined the women and enjoyed refreshments and several hours of cards. We have had these meetings regularly ever since.

The Hebo district normally has 11 guard positions during the summer season. Of this number, two positions are ordinarily filled by forestry school students. One position is usually vacated each season for one reason or another, leaving eight positions filled by returning nonstudent guards. Three of these guards live at some little distance from the ranger station, and it is not very practical for them to be present at the meetings, although one guard frequently attends, traveling 35 miles to do so. Attendance has not at any time been requested or made compulsory in any sense. It is thoroughly understood that a man's standing is in no wise affected by absence from the meetings, and also that attendance in itself has no bearing on his holding his job.

On an average six regular guards and one emergency guard have attended. During spring maintenance several guards from distant stations are on the district, and our attendance is increased by their presence.

In 1937, because of our late start, only 6 sessions were held, but we have had 9 so far in 1938, and shall undoubtedly get in 12. Eighteen hours of additional training for one-half of the regular personnel is well worth while; at least, I have found it so.

One of my problems has been to secure well trained overhead for class B and small class C fires. My approach has been to secure sufficient emergency lookout personnel and train them, so that I could use regular lookouts for overhead positions on the smaller fires. Many evenings have been devoted to subjects pertaining to the efficient ndling of these fires—timekeeping, the camp-manager job, com- ensation, the foreman, tool man, etc.

At one of the meetings it was suggested that a brief reminder list ight be of considerable assistance to men filling the overhead posi- ons. We have developed that idea and have prepared a one-page minder list for each job, arranged in a folder so that the list for each rticular job can easily be torn out by the man filling that job. This lder is a part of each 15-man tool cache and is carried in the time- eeping kit.

Other subjects discussed have been the calculation of probabilities, ublic contact, the one-lick method of fire suppression, the proper reparation of Forms LE–1, fire fighters contract and time slip, a udy of information necessary to complete Form 929, and trail and lephone maintenance standards.

The results and advantages have been numerous. From the stand- oint of morale alone the meetings have been worth while. I believe hat the fellows have a feeling that they are shareholders in the Forest ervice; and where previously a guard may have worked only 4 to 6 onths of the year, he now works for the Service continually. The pirit of teamwork seems to be more apparent. After several sessions n trail and telephone maintenance I noticed that a better and more ficient job was being done.

A meeting of this sort is a good place to put up a real problem, though it may sometimes be advisable to put it up as a hypothetical ase. I've profited from a number of worth while ideas brought up in ur sessions.

Several methods of training have been used, and I believe that a ariation or a change of gait, so to speak, is very effective in sustaining terest and preventing monotony. We have had informal round- ables with everyone throwing in ideas and taking ideas from the pot. Ve have employed the conference method with a chart, and have sed problems.

On occasions when we have made practical use of some of our ac- uired knowledge and training, it has been helpful to analyze and riticize our action constructively at our next session. We have even anufactured the occasions. After studying the one-lick method of re-line construction, we took 30 Farm Security laborers assigned to s for trail work to a trail construction job and practiced the one-lick ethod with them, giving the guards the third and fourth steps of the our-step method. It was generally agreed that we gained in output f production on trail construction as well as benefited by the training.

The next topic I propose to take up is training instruction, with mphasis on the idea that much of our trouble in supervising a crew f men results from assuming that a man knows how to do some simple et fundamental thing. If the boys can be taught to recognize this ondition, better production on fire control and maintenance work hould result.

As a result of the experience gained in conducting these meetings uring the past two winter seasons, I expect to give more attention o the following points in planning future meetings:

1. Take sufficient time to prepare adequately instructional material.
2. Limit the subject so that it can be thoroughly covered in not to xceed a 2-hour period.
3. Vary methods of instruction and procedure in conducting eetings.

AUXILIARY RADIATOR COOLING SYSTEM FOR FIRE TRUCKS

W. R. Oakes,

Sequoia National Park, Calif., National Park Service

The simple system described by the author should be a ready means of curing heating troubles in engines which will not cool when being used to discharge a load of water while the truck is standing still.

In Sequoia National Park, where the California sun frequently produces temperatures well over 100° F. and where truck-trail grades run as high as 20 percent, the conventional motor-cooling system of the fire trucks is inadequate.

Several experiments were made with various methods of providing greater circulation of water. The most successful was to supplement the standard system by circulating water from the truck storage tank through the motor block and radiator and returning it to the storage tank by means of a small electric pump. The system is easy to install and no alterations to the truck or its standard equipment are necessary. Anyone handy with tools can do the job. Three-eighths-inch copper tubing was used to carry the water throughout the system.

The pump used to force the water from the storage tank was a Stewart Warner electric (6-volt) fuel pump, Model A–699. It was bolted to the dashboard under the hood, low enough to permit the water to flow by gravity from the storage tank to the intake of the pump as long as the tank was at least half full of water. A push-button switch was installed on the instrument board to control the supplemented cooling system in order to permit the motor to reach an efficient operating temperature, or to cut off the flow when the storage tank is empty. One wire is run from the hot post on the ammeter through the switch to the pump, the latter being grounded to the frame upon installation.

Flexible metal tubing was used to carry the water from the outlet of the pump to the drain plug connection on the radiator, the point where the standard system was cut off.

A spring check valve, ball bearing, was installed between the end of the flexible tubing and the drain cock to prevent the water from the radiator draining back to the tank when the latter is empty, or the loss of water in case of failure of the supply line. A return line of copper tubing was run from the overflow pipe of the radiator back to the storage tank.

Since the fuel pump was not designed to pump water, the flat steel valve springs rusted quickly and were replaced with coiled brass valve springs originally designed for a mechanical fuel pump. (Flat brass springs could be substituted.)

The pump installed as described will deliver approximately 15 gallons of water per hour to the radiator. This has proved adequate for holding the water in the cooling system well below the boiling point.

The cost of the pump, tubing, and miscellaneous parts was approximately $15 for each truck on which the system was installed. The installation can be used on practically any model and make of tank truck.

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Volume 3 Number 2

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A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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TRAINING OVERHEAD FOR SUPPRESSION WORK

LEE P. BROWN

Training Officer, Region 2, U. S. Foreign Service

Few people will disagree with the author's opening statement that executive errors have contributed to failure to handle large fires efficiently. Since most of our fire losses come from large fires, we might expect much thought and action to be focused on training designed to prevent such errors. The contrary is true if the 1937 index to FIRE CONTROL NOTES is a reliable mirror of thought. Under the subject of training there are but two entries. Radio, a tangible and relatively easy subject, boasts seven entries. Training is a dull and unimportant subject compared with airplanes, cooperation, and fire lines, according to the space used in FIRE CONTROL NOTES. The author converts this situation into a challenge to fire-control men. How can there be effective training for large fires until fire experts stop rushing from one thing to another long enough to digest what they know and agree on just what skills and mental habits should be emphasized in the training of men? The author does more than issue a challenge. He lays the subject out in such a way as to invite men who believe in the importance of training for big fire work to take a hand in developing a body of accepted ideas which training specialists can use.

Every conference of fire-control experts and every analysis of cords of past fires emphasizes the fact that avoidable mistakes of ersonnel contribute, in some degree, to ineffective fire-suppression tion on many large fires. Some of the personnel failures are the sult of:

1. Mistakes in judgment—in timing, in planning, etc.
2. Failure to recognize potentialities.
3. Failure to function properly on the job because of inability to recognize place and duties in the fire organization.
4. Failure to see the job as a whole; this usually reflects inexperience.
5. Lack of administrative ability in organizing and directing crews.
6. Surrender to excitement, pressure, or fear.
7. Failure to apply knowledge of fire behavior, weather, etc.
8. Failure to adopt or combine techniques so as to secure the most effective action on fire.

Selection and Training

If the fire organization is to be strengthened and personnel failures inimized, there are two problems to solve. First, the selection of en; and second, their training. The two are inseparably linked. raining is essential to proper development, but the better the undation the more effective will be the training. Training may pply props for deficiencies inherent in the men, but props may ve way under strain.

It is desirable that men selected to be developed for overhead posions in handling fires have certain personal characteristics. Some of e more important are:

1. Indicated ability to plan and organize, and particularly ability to correlate.

2. Marked aptitude for administrative work.
3. Good health, particularly stamina.
4. Proved ability to work calmly and surely under heavy pressure
5. Good analytical judgment coupled with a high degree o initiative, originality, and a perceptive imagination.
6. Qualities of leadership which inspire confidence and buil loyalty.
7. Knowledge of the physical limitations (endurance) of th human machine, particularly one's own.

Men with a reasonable proportion of such qualities can be develope by training into efficient leaders for a fire organization. Any trainin program, however, must weigh the cost of training against the result secured. Although it may be possible to develop men with more o less fundamental deficiencies, the period of training is too long, th cost too great, and the assurance of satisfactory performance too un certain to warrant the attempt. The first problem then, is to analyz the job and determine qualifications on which a training program ca be built.

Methods, practices, and programs for training lookouts, guards firemen, scouts, and fire fighters are well developed and in genera accomplish the purpose for which they are intended. Detaile analyses giving the responsibilities of overhead positions, such a foremen, camp bosses, sector bosses, and fire chiefs on suppressio work, have been made. One such analysis held a number of officer in overhead positions responsible for several hundred items, eac under a number of general functions or operations. If these analyse are representative pictures of the job, perhaps we are asking for some thing that taxes human capacity too heavily. Certainly they indicat the need for a careful, systematic build-up of the officer's knowledg of his job and ability to perform on the job if he is to function surel and effectively on large fires. Are we tackling this training proble in the same way in which "guard training" has been made effective i increasing the efficient functioning of our primary protection force or are we, because of the exigencies of fire suppression work, trainin our overhead by the trial-and-error method? If we use the latte should we not charge a reasonable proportion of the errors up to trai ing and not condemn the inexperienced officer for his mistakes?

Overhead Training

In training overhead for large fire crews the major aims should b

(*a*) To develop the trainee's knowledge of fire behavior;
(*b*) To instruct the trainee in different methods of fighting fire;
(*c*) To develop judgment of the trainee in accurate appraisal fire behavior and in applying fire-control methods in practical manner;
(*d*) To develop foremanship of crew leaders in handling men the line;
(*e*) To give the trainee a knowledge of what is essential to go organization of fire-suppression forces and an understan ing of how officer should function to operate efficiently;
(*f*) To develop the capacity of the trainee to organize, direct, a correlate the work of fire crews quickly and effectiv (including the service of supply);

(*g*) To instruct the trainee in the mobilization and demobilization of large fire-suppression forces, their supplies and equipment;

(*h*) To develop the trainee's ability to recognize and appraise potentialities;

(*i*) To develop the trainee's judgment and skill in planning ahead so as to be in the best possible position for meeting such exigencies as occur;

(*j*) To give the trainee such guided experience and training that he will function confidently and surely under pressure on the job.

How can the instructor prepare himself for the job of training ompetent overhead for large fires? To what authorities and refer- nces can he turn?

In all the wealth of forest literature there is little on fire fighting hat can be used as a text. One excellent, although brief, booklet n fire fighting is the one put out by the Western Forestry and Con- ervation Association. Another is the new Region 5 Fire Control Iandbook.

Research has in its files a wealth of material on fire-suppression vork, but little of it is available or usable for instructional purposes. he average officer who has to train or develop men for overhead ositions on fires must rely for material largely on his own experience nd his own habits or practices of fighting fire. He may be excellent n some phases, fair in others, and poor or inexperienced in a few of he tasks involved in a fire-suppression organization. The men can- ot help but reflect the instructor's abilities and limitations. Under uch conditions might it not be well to check up on the instructor as vell as the officer who "blows up" in a fire organization?

So much for the general situation. The next step is to consider ne by one the broad subjects indicated in order to get a better idea f how they should be handled in the development of an effective raining program for overhead.

Fire Behavior

Research has made some study of fire behavior, but only a small art of its findings has been presented in such form that it can be sed for instructional purposes. Fire-control men apply their knowl- dge of fire behavior, but have rarely analyzed fires in terms of topog- aphy, physics, meteorology, or ecology. Where, then, do forest fficers get their knowledge of fires? The answer is by experience on res. The observant and those inclined to experiment can learn ertinent facts on fire behavior from an evening campfire on the trail, rom a pile of burning brush, from slash disposal fires of various kinds, s well as from forest fires.

Fire behavior on small fires is pretty well explained in guard train- ng. But is fire behavior the same on large fires? If it is, how can t be predicted for large areas? If it isn't, what differences are there nd how will they affect the task of fire control? When and where, or example, may an officer expect cyclonic drafts on a large fire? requent reasons for unexpected loss of line on large fires are that "the wind suddenly changed," or "a big wind came up and swept the re over the lines." Only occasionally, however, do weather records actually show any sudden, unusual, or material increase in wind velocities for that time of day. Has anyone ever tied the physical laws of gas or ether expansion to fire fighting? What combinations of topography, volume of heat, spread, weather, and the like may cause uncontrollable conditions? What indices may be used to foresee the approach of catastrophic conditions on the line? These are but a few of the questions a training officer must answer in developing and training officers on large fires. Your executive on a large fire must appraise fire behavior broadly; he cannot deal with it in minutiae. How can he be trained to do this?

Methods of Fire Fighting

Methods and techniques develop from experience. Only in the last few years have we heard of the station method, the one-lick method, and other methods and variations, yet every officer of experience will recognize in each the fundamental theories he has seen used repeatedly on fires. Here again, there has been more of doing and less of telling by the men who have developed the techniques. Methods have not as a rule been clearly defined, because fire chiefs have not fought a fire by the use of any one method, but rather by a variation and combination of methods. For example, Jim Girard taught me the use of the station method "way back when." He did not call it by name, and he originally used it primarily on mop-up work. Before that, I had been introduced to what I may call a "squad method," although I have never heard it named, and a head fire guard taught me an early variation of the one-lick method several years ago. A forest supervisor expounded the theory of "cold trailing." But I got all of this on the fire line, never anywhere else, and it's only in retrospect that I see it as instruction or training.

Since most reasoning is from the concrete to the abstract, isn't i logical that our techniques develop from fighting fires—and not tha fire fighting develops after techniques have been set up? Perhaps the previous thirty-odd years form an essential "cut and try" period Be that as it may, the training officer's problem now is to isolate these techniques, instruct in them, and then train in the common-sense application of them in various combinations for efficient fire-fighting work. The end sought is the trainee's ability to combine and apply his knowledge of fire-behavior and fire-suppression technique effectively.

Technical Judgment

Developing the judgment of an officer is difficult when dealing with concrete or physical things which must be appraised in order to arrive at correct conclusions or decisions. It is infinitely more difficul to develop judgment which deals with intangibles and potentialities and requires vision bordering on the prophetic. It can never be done with certainty where careful analysis and positive direction o the trainee's thinking and reaction is lacking. In short, the training of officers for overhead positions on fires requires the same long-tim planned training and experience that is required to develop judgmen in other important positions.

Is it not true that most firemen think in terms of their experience ather than in terms of fire behavior and methods? Start a discussion f fire behavior in a group of them and see how hard it is to keep the iscussion going and how little they think in terms of fire behavior. Try the same thing in a discussion of fire methods and note the earth of ideas. Watch the dog fight, however, when you toss an ctual fire problem into the group. You will find varying points of re behavior and of fire-suppression technique forming an ever-hanging basis for discussion. Is this not a natural sequence of the ay in which they have acquired their knowledge?

How often are the reasons back of fire strategy and important ecisions on going fires explained to subordinate officers, who, in many nstances, are admittedly in training? Have the key officers the time o do it while they are under pressure to get the fire? When should t be done? Where should it be done? How far should they go? hould they have the help of a training specialist? If so, what should heir relations to each other be?

Get any group of fire-control devotees together and get them tarted on the problem of training fire fighters and the invariable conlusion is: "The way to learn to fight fire is to fight it. Every fire is ifferent, you learn something from every one of them." For many ears men have been sent to large fires for training. At least the alue of the detail from a training standpoint has been considered. s the training being done on such details effective? Is it enough? hould there be more training details to going fires? If the way to earn to fight fire is to "go fight it," shouldn't every major fire be nade a training ground for junior or inexperienced officers? Here y common agreement seems to be the ideal place to train officers in re-suppression work. Yet the results of this method so far have ot been free from some disastrous failures. Some means should be ound to make the training of men on "fire detail" more positive, nd some means devised to appraise the effectiveness of the training o that on subsequent fires reliance may not be placed on officers whose raining did not "take."

Human psychology is such that we seldom see the self evident, let lone the supporting facts or reasons for things that happen, unless e are trained to do so. We are largely creatures of fixed habits—in hinking as well as in doing, and our thinking is not always coordiated with our doing. That is why the expression, "Don't do as I o, but do as I say," is so frequently heard. In our fire-suppression ork, for example, there is a wide spread between what is known bout fire behavior and the essentials of efficient line construction nd the corralling of fires, and putting such knowledge into practice. Much of the difficulty lies in the thinking and habits of fire fighters rained in the school of experience who continue to do things as they rst saw them done or learned to do them on the line, rather than to uestion, experiment, or adapt methods to the needs of each particuar fire. Every fire fighter will assert that every fire is different, and et isn't it true that fundamentally fires are fought the same in New England, on the Pacific coast, in the South, and throughout the Lake States? The technique boiled down is to get a gang of men, ive them a line, shovels, hoes or rakes, and a few axes and set them o throwing dirt or digging trenches.

Foremanship

The officer who is to direct fire-suppression crews must first of all be a good foreman, a leader, and handler of men. Knowledge of, or ability in fire-suppression technique will not compensate for lack of leadership. In fact, a good foreman who knows nothing of fire fighting except generalities will get more done on the fire line than will a technical expert on fire who cannot handle a crew. On a fire line, however, is no place to train men in foremanship. An axiom on a fire is that "if a subordinate can't handle the crew, replace him at once."

The Service may be accused of not training its men in foremanship in the past. Now, however, forest officers can take advantage of the training programs in the C. C. C. and E. R. A.

Does foremanship on the fire line involve anything different from foremanship anywhere else? Is foremanship important enough to receive special consideration in training for suppression work?

Knowledge of Organization

The basic essentials of good organization of fire-suppression forces are pretty well known, and it is not difficult to impart this knowledge to new officers. The trouble comes in getting the trainee to understand and appreciate how the members of such an organization shoulc function. As a part of the presuppression effort splendid work has been done in instructing field officers in planning and organizing fire-suppression forces. Check lists of duties have been made for the various jobs in an organization. Perhaps the inexperienced office needs to know what to do with his organization after he gets it; hov to make it function effectively in the suppression of fires. He need to be trained in analyzing his organization and in trouble shootin when it is in action so as to be able to correct weak spots before majo breaks occur.

Organizing Ability

The trainee must have certain innate qualifications or aptitude before he can be trained to organize, direct, and correlate the work o fire crews. This is largely a matter of executive ability which ma be developed by administrative work not connected with fire. Th problem in this case is one of training an otherwise competent office in the application of the principles of leadership to fire-suppressio work. If the trainee lacks executive ability, the start must be mad from scratch, and a long period of apprenticeship training in admin istrative principles and their application is involved. In either case the most difficult part is the development of the trainee's judgment because this makes up a large part of the skill of an officer in any forn of executive work. The trainee must have not only an adequat basis of fact or knowledge, but also must be experienced (practiced in the correct use and application of that knowledge until he is efficien in organizing, directing, and correlating the work of fire crews.

Mobilization and Demobilization

Mobilizing and demobilizing fire organizations can be considered s a mechanical process for the service of supply. When, where, and ow, is largely a matter of administrative decision for the fire chief. oth phases require administrative skill and judgment, and what as been said before would apply equally here.

Recognizing Potentialities

Someone has said that, "If our foresight were as good as our hindight, we'd all be better off by a damn sight." An nowhere is this ruer than on bad fires. The highest type of skill is required to foresee erious situations before they arise and to plan the attack so as to eet the trouble adequately when it comes. Ability to do this can e developed only where the trainee has been given all the basic trainng and experience essential to the job and is then trained in the critical se of that skill as a fire strategist.

Development of the capacity to recognize and appraise potentialies and ability to marshal fire suppression resources so as to meet uch exigencies as occur is the final step in building officers for comand of suppression forces. It can be accomplished only by a areful build-up of the officers concerned over a long period of trainng in which experience on fires intelligently analyzed and applied orms the primary factor of instruction. Matters of regional policy nd the opinions and judgments of inspecting officers all affect the aining problem. There must be a uniform understanding or interretation of regional policy; men must be taught not to go to extremes. nspecting officers must get all the facts and must distinguish between eir opinions and their judgments. Whenever comment or criticism y inspectors is not fully explained by facts, the trainee will be further onfused and judgments which may have been building up for some me are likely to be vitiated. The inspecting officer at this stage of e development of officers must consciously and conscientiously place imself in the position of an instructor. To do this he may use the cts gained from inspection, but he must use them with the attitude nd approach of a trainer, not an inspector.

Confidence in Action

Most officers are more or less nervous and even panicky when they ave to handle their first fire "on their own," regardless of its size. he less experienced the officer, the greater the likelihood that this eling may seriously interfere with his effectiveness in directing the re-suppression work. Occasionally officers of considerable experince will "go to pieces" on a fire. Many times it is only temporary; e officer soon "gets his feet on the ground." Training, habit, and iscipline assert themselves, and he is able to function effectively in ite of himself. Besides inexperience, the physical condition of e officer, a combination of adverse breaks, not having had a bad fire r a number of years, or any one of a number of causes, including ncompetency, may cause him to "blow up." Perhaps there is no panacea, no training which will prevent the occasional break from lack of or loss of confidence and the surrender of an officer in command to excitement, pressure, or fear. Training and experience on fires will minimize the chance of going to pieces, but the human element must be considered with all the charity possible when such trouble does occur, even though appropriate action must be taken after all circumstances and results are determined.

Summary

Summarizing the problem of training overhead for fire-suppression work we find that:

1. There is need for training in certain basic knowledge of fire-suppression work as a foundation.
2. It is necessary to train in the application of that knowledge.
3. The major problem is one of developing confident leadership, supported by well developed administrative ability and sound judgment in the executive and technical work of fire suppression.
4. There are certain limitations beyond which training and experience cannot go.
5. No new training methods are involved.

Perhaps the most vital factor is not only the recognition of the need for training, but also the acceptance of the responsibility for training by those in charge of fire-suppression work. Much of the training necessary can be given only by those "in command." Possibly we need to go back of our overhead failures on fires and check up on the officers under whom the personnel were trained for deficiencies in executive ability and skill in training.

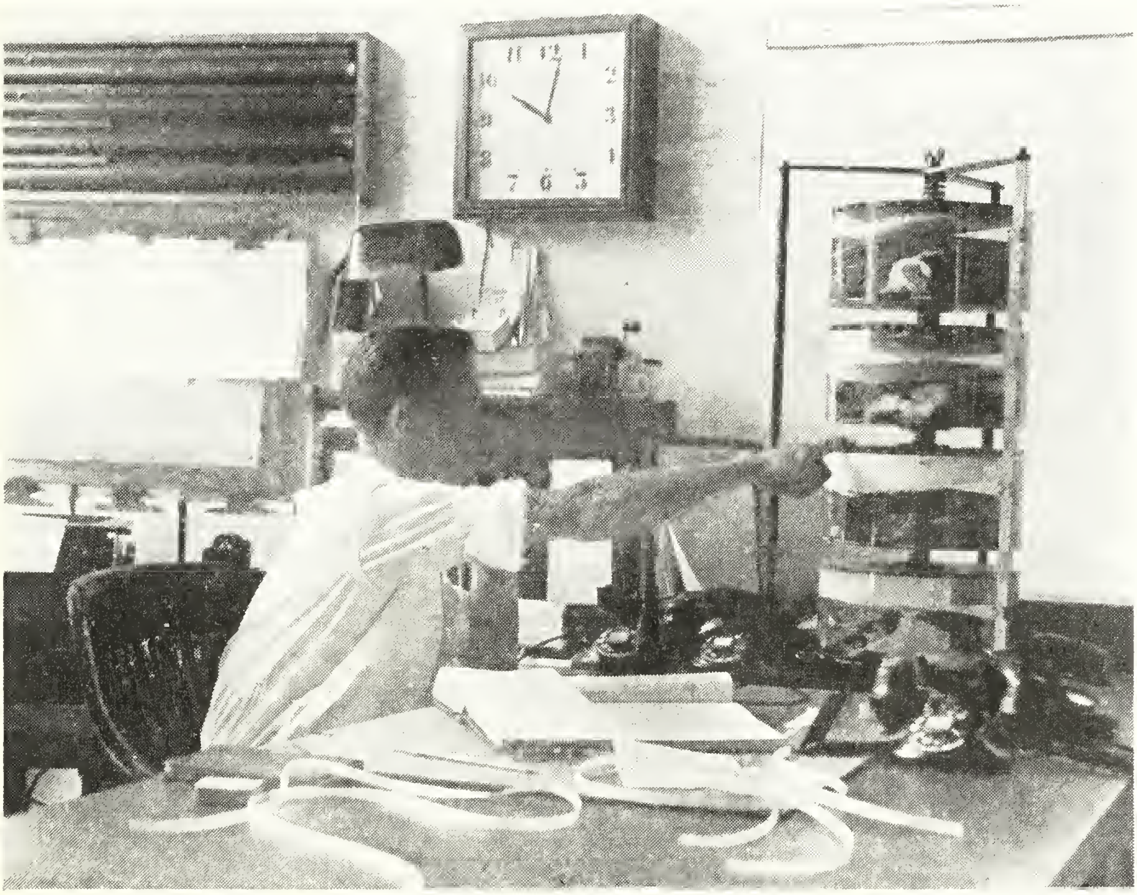
A great spread exists between what is known and what is practiced in corralling, controlling, and mopping up of fires. Part of this is the result of following established habits of work; part is the result of the failure to think. Training to date has been largely concentrated on the "doing" end of suppression work. The training of overhead involves primarily instruction in analytical and critical thinking in fire suppresssion. This is a harder, slower task, because it calls for the conscious guidance of the mental reactions of the trainees. Greater progress will be made when thinking is more closely coordinated with doing in corralling and controlling fires.

APPLICATION OF PANORAMIC PHOTOGRAPHS IN LOCATING FOREST FIRES

Bernard H. Paul

Assistant in Charge of Intelligence Division, Los Angeles County Department of Forester and Fire Warden

The fire detection system of Los Angeles County, Calif., consists of 26 lookout stations, 10 of which are operated by the County Department of Forester and Fire Warden, 14 by the United States Forest Service, and 2 under cooperative arrangement. Each of these observation units is equipped with an Osborne fire finder, providing both vertical and horizontal angle readings.

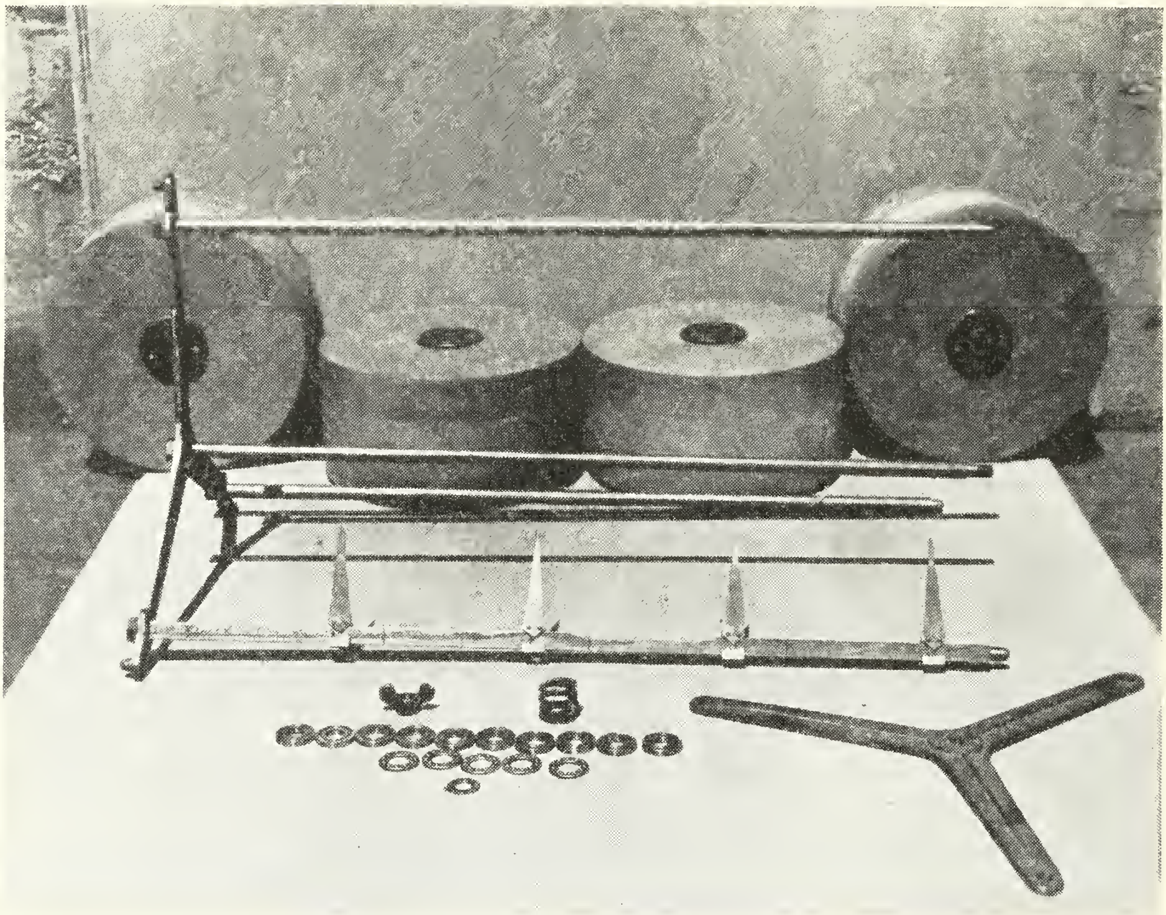


Rotating panoramic photographs being used by dispatcher.

Since the ordinary dispatcher's map recognizes application only of he horizontal arc, in order to take full advantage of these instruments t was necessary to devise another method of interpretation. This onsists of a rack, or stand, containing panoramic pictures taken from our different towers whose coverages are composite. These photographs, upon each of which is superimposed azimuth circles reading o 30 minutes or arc, are mounted on the periphery of separate drums whose perimeters equal the overall length of the prints. The drums are placed upon a vertical spindle and revolve on ball bearings on a horizontal plane.

One of the three side braces is equipped with four adjustable pointers, one for each drum. Vertical movement of the pointer is directed by a scale giving plus or minus angles from the horizontal.

The operation of the instrument is simple. With the azimuth and vertical angle given by the observer, the dispatcher rotates the drum until the pointer is coincidental with the readings. Familiarity with the terrain is vitally necessary, particularly on those instances where indirect observations occur. Cross-readings, or intersections, are obtained visually from an inspection of the position indicated by the pointer on different drums.



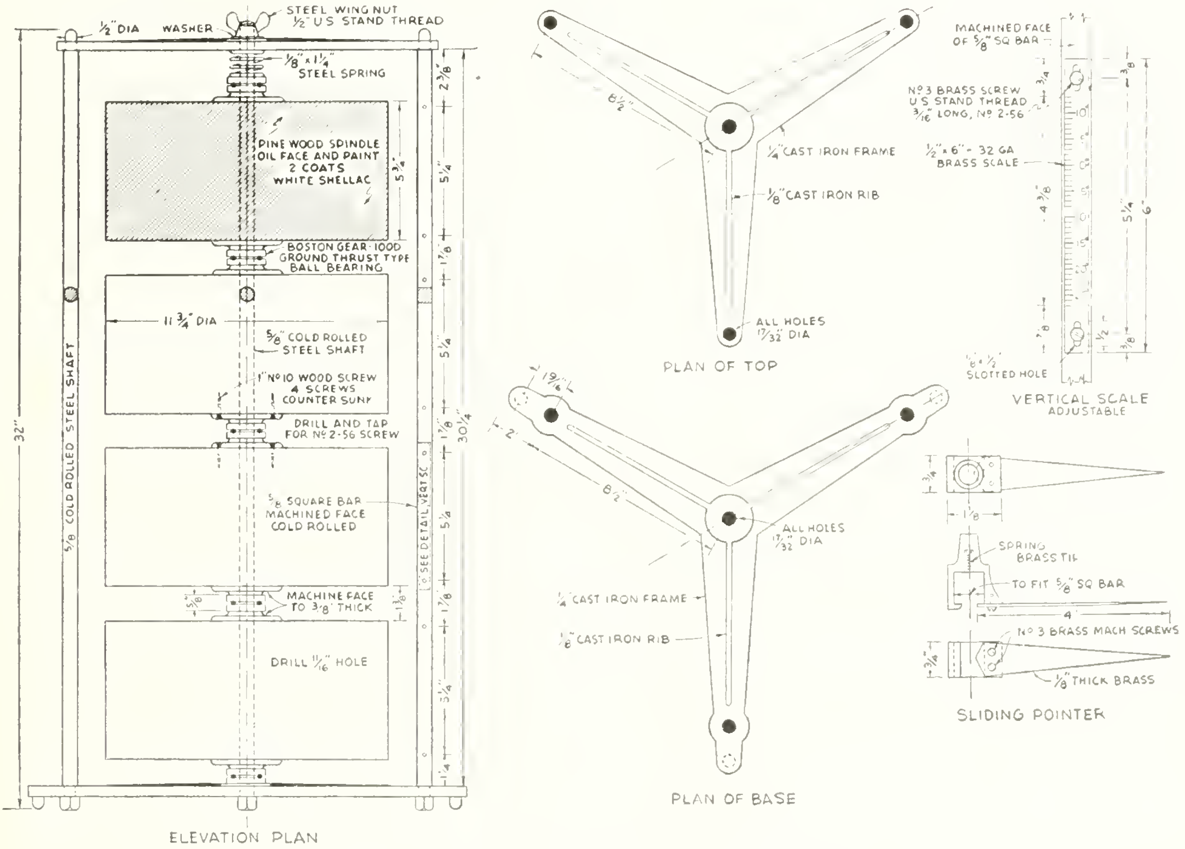
Component parts of the rotary rack.

The whole assembly takes up little room and can be placed on the desk within convenient reach of the dispatcher, which obviates the necessity of leaving the phone unattended as in the use of the standard wall map. It also permits operation during conversation with the observer.

The value of this device as a public relation factor is important. The "topog" map, azimuth circles, and strings are somewhat difficult for the layman to comprehend, but he readily understands a photograph, particularly when it depicts country familiar to him. People are attracted by anything that moves, and once the drum is revolved before the inquirer's eyes he is interested and his attention is obtained Pertinent questions aroused through this medium provide an excellent opportunity for the fire warden to spread the gospel of fire prevention.

The instrument itself consists of two castings, the bottom support and the cap, a central spindle, and three braces. Two or the vertica side rods are cold-rolled steel, and the third is a square bar upon which are fastened the scales and the adjustable pointers. The drums are o seasoned sugar pine with ordinary pipe flanges for hubs and are separated by annular ball races. The pointers are held in place by friction device consisting of a small coil spring and a ball bearing. A arger coil spring placed between the topmost drum and the bracket exerts sufficient pressure to regulate the turning movement of the drums, as well as to compensate for lateral movement on the spindle. The whole assembly weighs approximately 40 pounds. It can be dismounted quickly and alternate drums may be set in place within a few moments.

A local engineering concern has built a dozen of these rotary fire finders on this department's specifications at a cost of about $30 per unit.


STEEL WING NUT ½" U.S. STAND THREAD
½" DIA
WASHER
⅛" × 1¼" STEEL SPRING
PINE WOOD SPINDLE OIL FACE AND PAINT 2 COATS WHITE SHELLAC
BOSTON GEAR 100D GROUND THRUST TYPE BALL BEARING
11¾" DIA
⅝" COLD ROLLED STEEL SHAFT
1" No 10 WOOD SCREW 4 SCREWS COUNTER SUNK
DRILL AND TAP FOR No 2-56 SCREW
⅝ SQUARE BAR MACHINED FACE COLD ROLLED
MACHINE FACE TO ⅜" THICK
DRILL 11/16" HOLE
⅝ COLD ROLLED STEEL SHAFT
SEE DETAIL VERT SC
32"
30¼
2⅜"
5¼"
1⅞
1¼
ELEVATION PLAN
6½"
¼" CAST IRON FRAME
⅛" CAST IRON RIB
ALL HOLES 17/32" DIA
PLAN OF TOP
19/16
2
¼" CAST IRON FRAME
⅛" CAST IRON RIB
PLAN OF BASE
MACHINED FACE OF ⅝" SQ BAR
No 3 BRASS SCREW U.S. STAND THREAD 3/16" LONG, No 2-56
½" × 6" - 32 GA BRASS SCALE
⅛" × ½" SLOTTED HOLE
VERTICAL SCALE ADJUSTABLE
6"
SPRING BRASS TIP
TO FIT ⅝" SQ BAR
No 3 BRASS MACH SCREWS
⅛" THICK BRASS
SLIDING POINTER

Plan of rotary fire finder using panoramic photographs.

AN IMPROVISED FIRE-HOSE BRUSH

J. E. Ritter

Region 7, U. S. Forest Service

Every fire fighter who has use for and access to power pumps is confronted with a current maintenance job, as well as the annual problem of storage of fire hose.

Even a double-cotton-jacketed, rubber-lined hose or a linen hose of substantial weave is subject to wear if much abrasive material is encountered in the field. Cleaning the hose in preparation for the next fire or for winter storage also subjects it to wear. Some recommend that brushing linen hose in any manner be avoided. Others suggest light brushing to get off the dry mud and dirt.

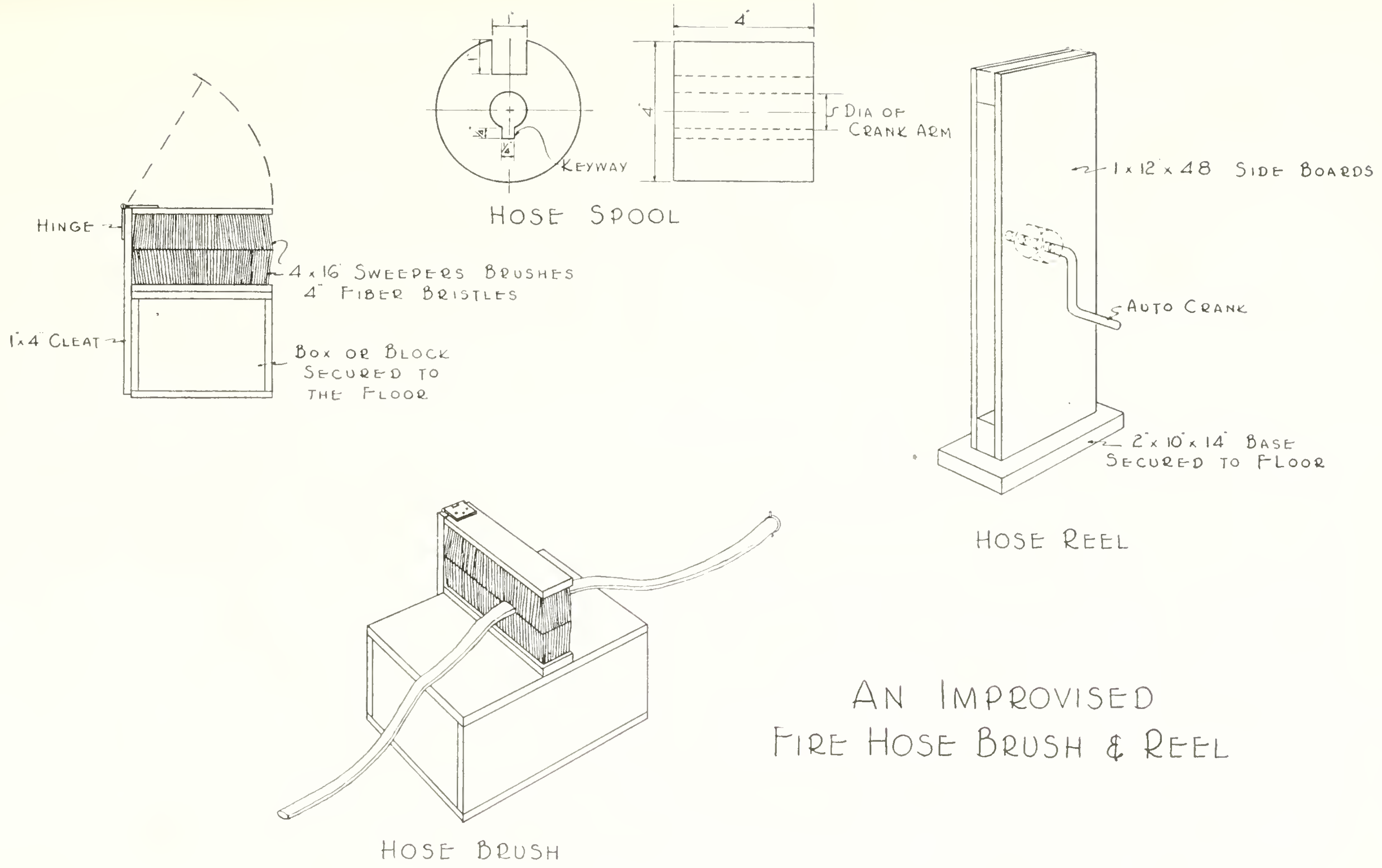
When traveling in New York State last summer I observed a brushing device built by a fire-control man. It was simple, inexpensive, but effective. A homemade hose reel was constructed from a couple of breast-high uprights of 1 by 12-inch material fastened to a base standing on end, spaced a little wider apart than the width of dry hose (1½ inches diameter), through which was inserted an old automobile crank with core to hold a bite of hose preparatory to reeling up the section.

Fastened to a box or stand approximately 2 feet in front of the reel were the heads of two fiber brooms (approximately 4 by 16 inches, with 4-inch fibers), one inverted over the other. The lower one was fastened securely to the stand while the other was hinged so that it might be opened for inserting hose and then closed or tightened with the hand or foot to obtain the desired pressure.

The hose is placed between the fibers of the two brooms in a horizontal position, inserted in the reel and coiled into compact rolls of convenient diameter by merely turning the crank, applying pressure on the brush sufficient to knock off the dirt. If the hose and mud are extremely dry, the mere weight of the brush will be sufficient to take off the dirt with little if any danger of injuring hose threads.

The type of brush used in the hose cleaner was adopted, I understand, merely to utilize materials on hand and to avoid further investment. Many other types of fiber or bristle brushes should be just as effective.

The reel described is most suited for 50-foot lengths of unlined linen hose. The accompanying sketch of the device may be of assistance to others in developing and constructing types of cleaners adaptable to other sizes of hose.



This simple fire-hose brush is inexpensive, but effective.

PORTABLE HOSE REEL

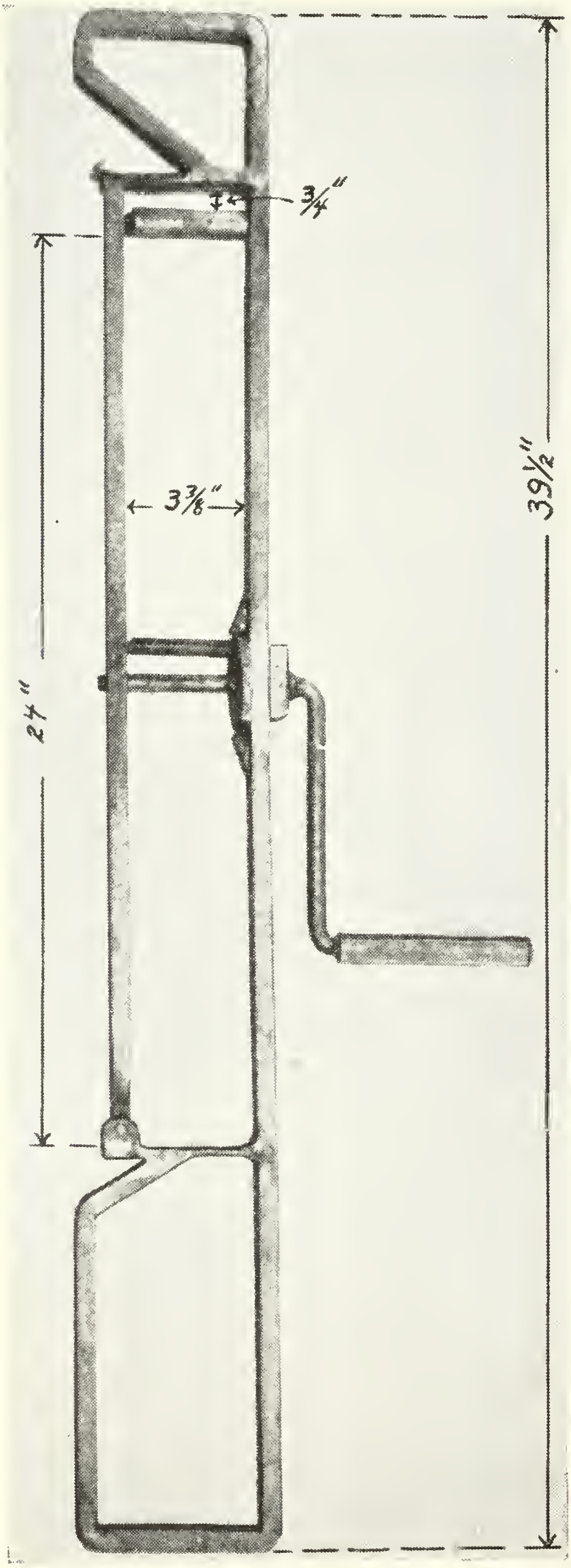
A. P. Swayne

Superior National Forest, Region 9, U. S. Forest Service

Historically, the need for a portable reel to handle marine pump hose was first felt at the Rocky Lake fire on the LaCroix Ranger District of the Superior National Forest during the 1937 fire season. With 5,000 feet of hose to be moved several times, the problem of rolling and laying it out became acute. The remoteness and roughness of the area brought out the necessity for lightness and portability in any reel developed.

The essential features of the reel illustrated are easily understood. A staff, with a hand grip at the top and a stirrup at the bottom, makes up the entire frame. A bearing is set near the middle of the staff with an axle slightly longer than the thickness of the staff. The axle is turned by a crank with a folding handle. On the other end of the axle is the fork. This consists of two tines, of which one is the prolongation of the axle and the other is offset from it about 2 inches and parallel with the first. Their length is equal to the width of the hose when flat. A hinged hose guide that latches in position beyond the fork is the only other part.

In rolling up a length of hose the reel is first set at about the middle of the hose and the hose guide opened. The hose is then laid between the tines, the guide is closed, and by turning the crank the hose is reeled into a compact roll. A groove in the offset tine facilitates tying the roll, and the guide is then opened and the hose may be lifted from the tines ready to be transported. The hose, rolled from the middle, reels in much more rapidly than when rolled from one end The couplings are on the outside of the roll and may be screwed together a couple of turns to prevent battering of the threads. The rubber gaskets can be left in place without chance of getting lost when this is done. The action of the reel gives



Weighing only 7 pounds, this portable reel is so shaped that it will pack readily with any pump-equipment outfit.

hose with water in it a chance to drain from both ends, making it unnecessary to drain hose before rolling for short quick moves, and thereby saving much time.

The weight of the reel is 7 pounds when made of seamless tubing. Its shape lends itself readily to packing with any pump equipment outfit. The illustration shows a model made of channel iron, but the weight of this material makes its use undesirable. The material recommended, and which is being used, is ¾-inch diameter, 18-gage, cold-drawn, seamless tubing.

Use of this reel, by furnishing a quick and easy method of moving hose, should cut down the tendency to drag hose for short moves under the stress of fire conditions. Increase in the life of the hose should be the result.

Past experience in rolling hose by hand and tests with the reel indicate that under fire conditions it will likely be fairly easy to cut the time of picking up hose by 40 percent and stringing it out by 20 percent. Inexperienced C. C. C. enrollees were used for these tests. The tests with dry hose were made on level, cleared ground. The test using wet hose was made on rough ground, following a crooked trail through timber, under conditions similar to a fire trail. The results of the tests follow:

TEST 1. DRY HOSE

	Seconds required to roll by hand	*Seconds required to roll by reel*
100 feet linen hose	90	5
	80	10
	85	5
Average	85	7
50 feet rubber-lined hose	65	5
	65	5
	65	5
Average	65	5

TEST 2. WET HOSE (PARTIALLY FULL OF WATER)

(*a*) Time required for one man to uncouple, roll by hand, tie, and sack 3 lengths described above was 10 minutes and 30 seconds.

(*b*) Time required for one man to uncouple, roll from the end with the reel, tie, and sack the same hose as (*a*), about 6 minutes and 30 seconds.

ELAPSED TIME CALCULATOR

Region 1, U. S. Forest Service

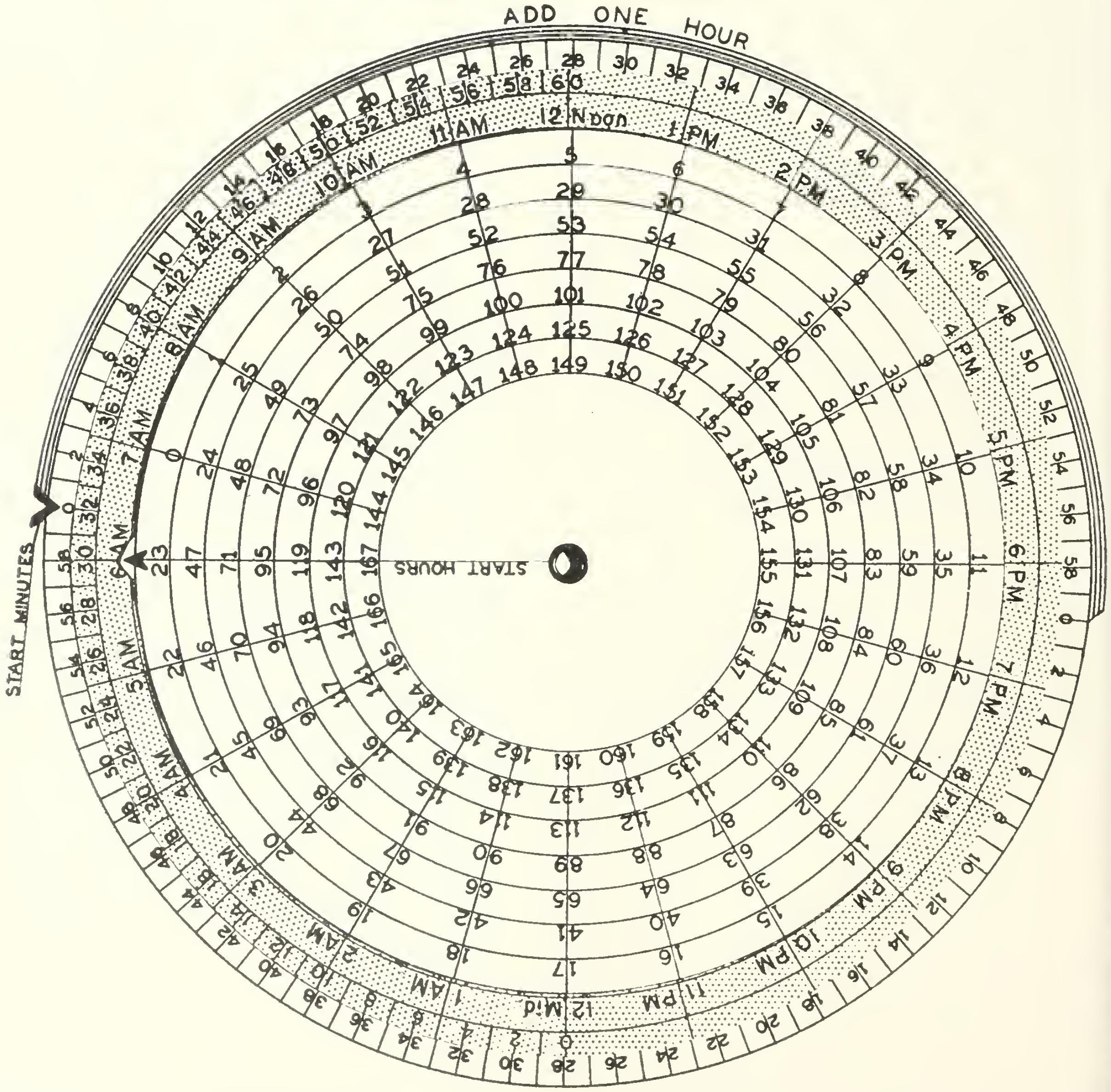
Region 1 saves time and improves accuracy by the use of the 8-by-11½-inch card illustrated. The small and medium dials are attached to the card by a simple brass eyelet. The large dial is printed on the card itself.

The instructions on the card are as follows:

Figures on small circle indicate elapsed time in hours, each succeeding line toward center represents a 24-hour period. Figures on largest circle indicate elapsed time in minutes, upper half represents 1 hour and minutes as indicated.

Figures on middle circle indicate the time of day in hours and minutes.

Example.—To calculate elapsed time from 6:32 a. m. July 21 to 4:18 p. m. July 25: Set pointer on small circle at 6 a. m., move both small circle and middle circle until pointer on larger circle is at 32. Then read hours on small circle down 5 places at 4 p. m. we find 105 hours; then read large circle where the figure 18 is located on the middle circle and we find 46, which gives us 105 hours and 46 minutes, total elapsed time.



To determine the number of places to count off on the small circle (from outer row towards the center) determine the exact number of full 24-hour periods between the two time figures and dates used, allowin one place for each full 24-hour period, beginning with the second place of the figure row. If the minut reading on the last date falls in the upper half of the large circle, add 1 hour to the reading in hours shown o the small circle. If the minute reading falls in the lower half of the large circle, use the reading shown o the small circle for the time indicated.

A FIRE-CONTROL TRAINING MAP

H. B. Rowland

Project Forester, Farm Security Administration

Often in connection with fire-control training, it is difficult to put over properly certain phases of the work by explanation, diagram, or other usual methods of presentation. One difficulty is to present a bird's-eye view of the entire fire and the whole process of suppressing it. It would help if we could picture vividly the necessity of concerted and coordinated effort, and the relation of each man's job to every other job and the part they all have in successful accomplishment. Another problem is to visualize the importance of time and quick, accurate judgment. Fake fires and small burnings are of some help, but they have their limitations. Several years ago, the writer, having these problems in mind, developed an animated relief map on which experimental fires could be burned.

At first, a small indoor model 3 feet square was made of asbestos plaster, with a scale of 1 foot to the mile. Since then, a large 10 by 15 foot outdoor model has been built of concrete. The relief maps were taken from a standard topographic sheet. All the usual characteristics are represented, roads, trails, streams, towns, towers, and warden locations. A large visible scale helps as a yardstick.

In use, the map is dusted over with a green inflammable powder made to burn at a given rate of speed. The powder represents the inflammable forest fuel and burns with a slow, creeping, sputtering action without flame.

The powder is a mixture of wood flour and saltpeter, with a dash of chrome green pigment for color. About 23 parts by volume of wood flour and 1 part pulverized saltpeter, thoroughly shaken together, should make the proper mixture, although a little experimenting must be done. A few less parts of wood flour make a "flash" powder and a few more parts make a fuel that is too slow or that will not burn at all. Several types of fuel make variable conditions on the same set-up. All unburned powder can be brushed up for future use.

On a large map several problems may be worked out with one dusting, or the map may be brushed off and repowdered each time. The powder is used about ⅛ inch deep, but variation in amount offers different conditions. The rate of burning is regulated by the mixture used. The speed of burning over the map gives a time scale for all action. In use the passage of time is marked by a timekeeper or large clock face. On the scale suggested, 1 minute represents 1 hour of time.

A small stylus was devised to rake the powder aside as in a raked fire line. The stylus was figured to scale on the basis of a 10-man crew. On the map-scale mentioned, an ordinary pin with the head clipped off set in a small stock or pencil answered the purpose. With such a gadget one can rake line on the map at a rate representing the work of 10 men raking line through ordinary hardwood conditions. One soon becomes tired trying to beat the line scale too much and unless the line is raked correctly and safely the fire usually creeps over.

So far the experiment has been based on the average powder burning normally. A little adjustment of the powder makes fast or slow burning fuel or fuel that will not burn at all. Well dried fuel will burn faster than that at ordinary room conditions. A small electric fan speeds up the fire and a gusty wind may even cause small spot fires to jump ahead, as a mere spark ignites the powder. With all these combinations of wind and fuel, it is possible to simulate almost any fire condition even to a complete "blow-up." Special care must be taken to see that the various scales are correctly worked out.

With a judge, timekeepers, and observers appointed and the conditions explained, other men are selected for fire boss, wardens, towermen, runners, helpers, etc., each man handling his own part. Helpers are sometimes needed to carry out the work of some officer, since the time element is speeded up. A small mimeographed map of the set-up may be of assistance.

A spark or match starts the fire. It spreads in all directions. The fire is discovered and reported, in the proper or designated elapsed time, by the towerman using a small map and alidade. Wardens are called and travel to the fire by elapsed time of distance and time scale. Upon arrival the warden sets to work to surround the fire with a safe line. His stylus keeps him in scale. When the fire reaches his line, it goes out for lack of fuel if the line is safe, or he may backfire with a helper. If the line is not safe, the fire usually creeps over. The break-over is handled only in scale for discovery and travel back and at the expense of the forward line. According to the burning conditions created, the fire may be a simple one-man fire of a few minutes or a many-crew fire of longer duration.

Any changes, additional crews, and the handling by the fire boss must be done according to time schedule for scouting, messages, travel, etc. This often shows quite obviously the exasperating things that happen on a fire because of the changes continually brought about through time. Often it is easy to see on the map immediately what should or could be done to take care of a certain situation then plainly visible—only to see the chance lost as the time element has its play. The map also gives a bird's-eye view of all parts and the simultaneous actions which are taking place on all sides to complete the whole. All work done is left recorded in the ash or dust after the fire is over, which makes possible a detailed review. One may in this way use the device as a problem table, or an instructor may use it alone to demonstrate methods and procedure in handling a fire.

Quite easily and naturally the results of good and poor judgment, delay, confusion, misunderstanding, haste, etc., may be seen. Action may be allowed to follow a natural course, or a situation may be deliberately worked up to a definite problem for individuals to tackle. With a little planning and manipulation actual fires may be reenacted in miniature. Innumerable modifications and adaptations are possible, but the fire actually burns and makes its own problems and must be put out if it is to be stopped.

In this day of intensive training for fire control in Federal and State service and C. C. C. camps, a training map such as that described might be of value to training officers and others. Such maps are quite easily made and inexpensive. They offer possibilities for real action, interest, and instruction, limited only by the imagination and resourcefulness of the directing officer in devising problems and details.

FUEL FEED SYSTEM FOR FIRE PUMPS

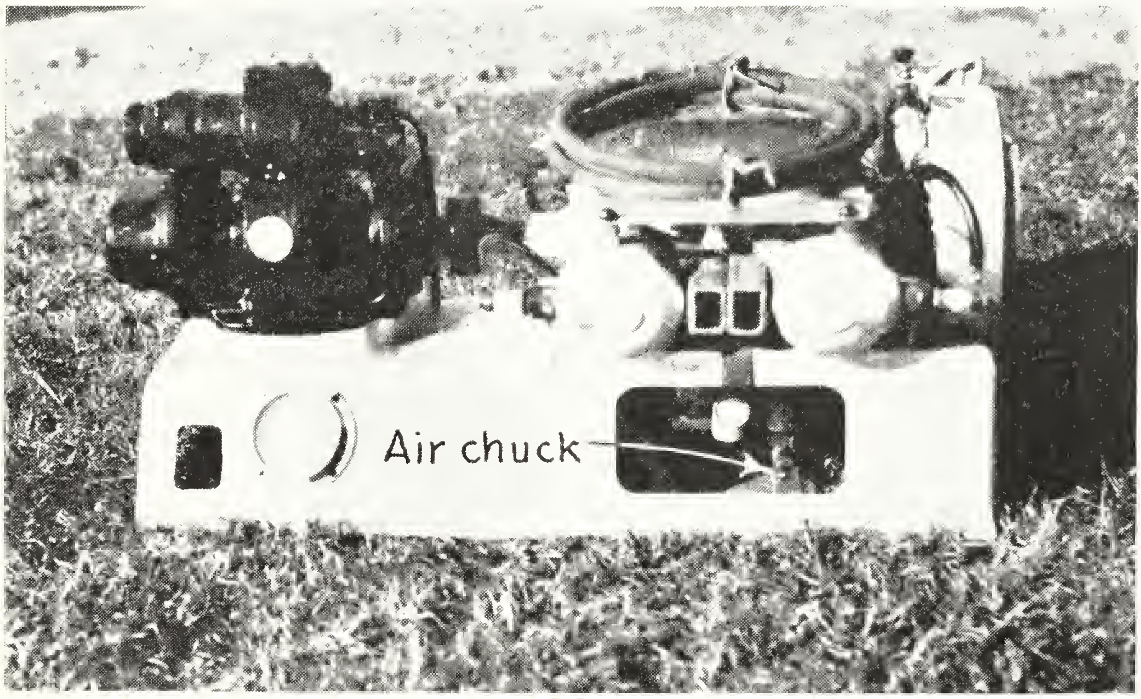
Benjamin A. Wiley

Mechanic, Superior National Forest, Region 9, U. S. Forest Service

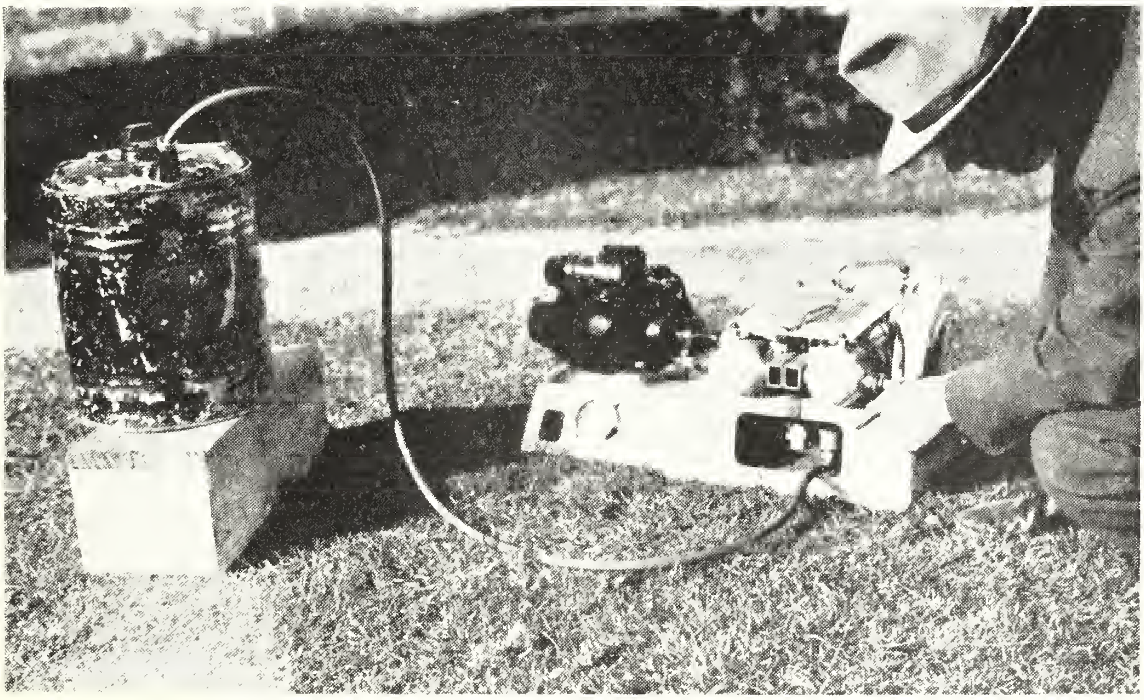
Comprised of: One ¼-inch, red rubber-covered air hose 7 feet long, and one Schrader air-chuck coupling, ¼-inch in size.

Total cost: Approximately $1 for both hose and coupling.

How to construct: Remove present ⅛-inch feed line from settling basin and enlarge hole with ¼-inch drill to take ¼-inch copper pipe. Insert and solder in ¼- by 1½-inch copper pipe. Insert other end of pipe



Fuel-feed unit unassembled for transportation or storage. Note position of air chuck.



Fuel-feed unit assembled for operation showing flexible-rubber air-pump hose attached to air chuck on carburetor feed line.

into the air-chuck coupling and solder in securely. Run ⅛-inch drill through coupling to enlarge passage and to remove any solder which may have entered pipe.

Time required to construct: 10 to 15 minutes.

Designed to eliminate: (1) Clogged fuel feed pipes caused by dried sediment and scale which collects in fuel tanks during periods of nonuse; (2) the soft, easily crushed and leaky gas tank with its attendant fire hazard to the pumper itself; (3) the necessity of stopping the pump every 45 minutes for refueling, thereby saving 1 hour of each fire-fighting day lost in refueling the small tank—this usually hurried refueling often results in overfilled tanks, with more fire hazard, oil-soaked spark-plug wires and magneto parts; (4) the necessity of carrying a funnel.

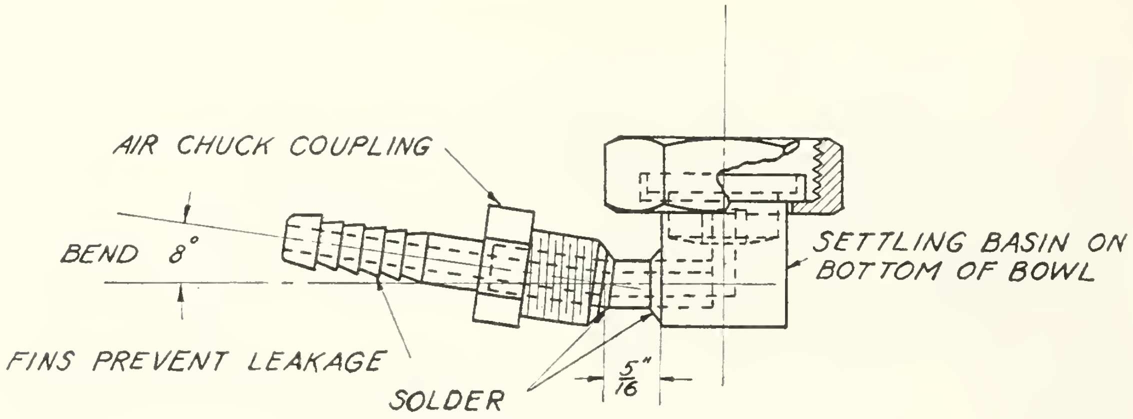


Diagram showing details of fuel-feed system.

Provides: (1) An uninterrupted safe fuel supply; (2) a fuel system that can be completely cleaned in 3 minutes.

Tested: (1) By many hours in actual service; (2) hose tested by soaking in gasoline for 200 hours.

Reaction: Hose swells, but not sufficiently to interfere with fuel supply. After removing from gasoline it returns to its original size in a short time.

METHOD FOR MEASURING PERIMETER OF FIRE

George M. Byram

Appalachian Forest Experiment Station

In Fire Control Notes for December 6, 1937, J. A. Mitchell described a rule of thumb for computing the rate of spread of a fire in terms of the rate of perimeter increase. According to his rule, the rate of perimeter increase of a fire is equal to approximately 3 times the rate at which the head of a fire is advancing. As Mitchell points out, if a fire spreads at equal rates in all directions, the rate of perimeter increase is 2π or 6.28 times the radial rate of spread, but since fires burning in a wind tend to spread primarily in one direction, the ratio is more nearly equal to π, or approximately 3.

A similar method can be used to estimate accurately the perimeter of a fire regardless of its shape. If the boundary of an irregular area A, such as that illustrated, is paced so that the pacer always keeps at a constant distance d from the boundary of area A, the perimeter of A will be equal to the distance traveled by the pacer minus $2\pi d$, or approximately $6d$. For instance, if the pacer always traveled at a distance of 30 feet from a burning fire, he would subtract 6 by 30 or 180 feet from the total distance traveled to obtain the correct fire perimeter.

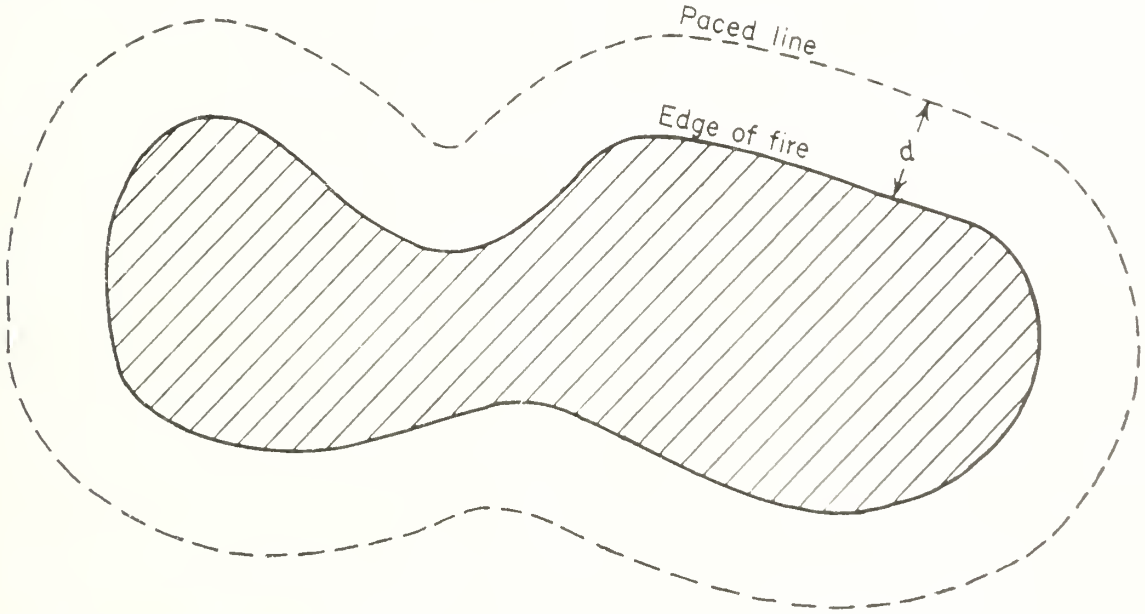


Diagram illustrating method of measuring fire perimeter. The perimeter equals the length of the paced line minus $2\pi d$.

It might appear that this rule would hold only for circular areas, but it can be shown mathematically that it applies to any area regardless of shape. A practical difficulty would be encountered on fires where narrow necks or intrusions had widths less than $2d$. In such cases, if the pacer kept at a distance d from the burning edge, he would be obliged to walk partly within the adjacent burning area. However, this condition probably is seldom encountered in actual practice.

If the fire spreads at an appreciable rate while the pacer is measuring its perimeter, he will not be able to close the curve when he reaches the starting point. However, if he stops opposite the starting point on a line perpendicular to the fire's edge, he will obtain an approximately correct perimeter.

METHODS OF USING DRIVEN WELL POINTS FOR FIRE-SUPPRESSION PURPOSES

L. J. Ashbaugh

Assistant Forester, Upper Michigan National Forest

The use of driven well points to obtain water is known to many men who are concerned with the suppression of forest fires. Their use is quite limited, however, depending upon the nature of soils and the depth to water-bearing levels. Where a large percentage of the area in which fires occur is in swampland or sandy, rock-free highlands, having relatively high water tables, well points can be used to very good advantage. They can be driven to depths of 30 or 40 feet under optimum conditions. Ordinarily 10 to 20 feet is more within the driving range in swampy areas because of the high water table.

The methods described here have been used on the Upper Michigan with good success.

The Well-Point Driver

A well-point driver is necessary in order to quickly and efficiently drive pipe to required depths. Two men can drive pipe without loss of time with the driver shown in figure 1 in the illustration.

In using the driver the following points should be noted:

1. Always cap the driven pipe to avoid punching a hole in the babbitt, to give larger striking surface, and to avoid injury to threads of pipe being driven.
2. Pipe lengths should not be cut longer than 6 feet.
3. Pipe joints should be leaded to eliminate suction. In the field a bar of brown laundry soap used on the joints is sufficient.

The well-point driver is of relatively simple construction. The cap should be acetylene welded to avoid its being punched out by the force concentrated on it during driving. Holes are drilled through the pipe at the points indicated in the drawing to take the ¾-inch tool-steel handle. The handle should have a snug fit. The babbitt will hold it in place.

Use of Single Well Points

Well points should be 3½ or 4 feet long; 60-mesh screen is usually considered best for all purposes; 1¼-inch points are in general use.

Single points may be driven and a standard well or a pitcher pump attached. The pitcher pump is most desirable where the water table is high, because of ease in handling and attaching it. This type o driven well is of most value for filling water and pump cans where water is not available nearby or must be hauled long distances.

Use of Multiple Well Points

Two or more points can be driven for use with a power-pump unit and will supply a steady flow of water for use in mopping up hot lines.

In order to draw from as large an area as possible the points should be located 8 or 10 feet apart. This will take better advantage of water bearing levels, and also avoid bunching equipment and men at work. While a second point is being driven the first may be rigged and attached to the pumper.

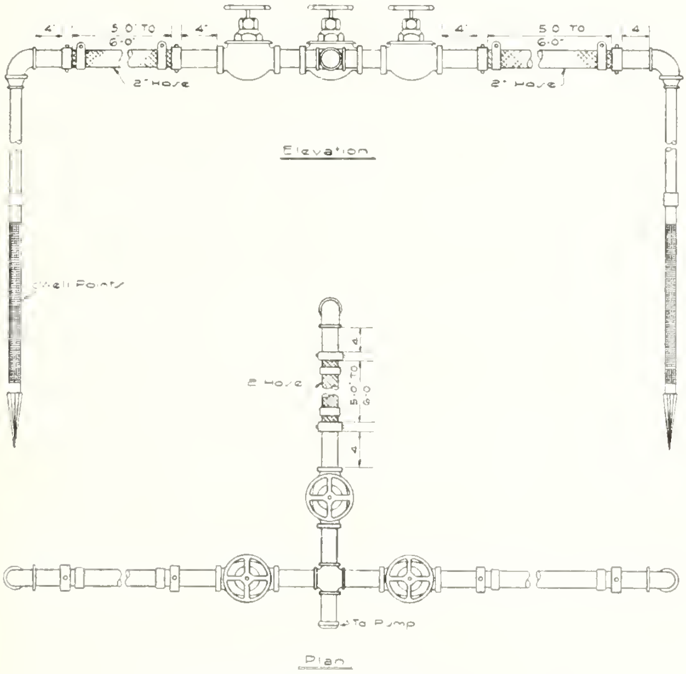
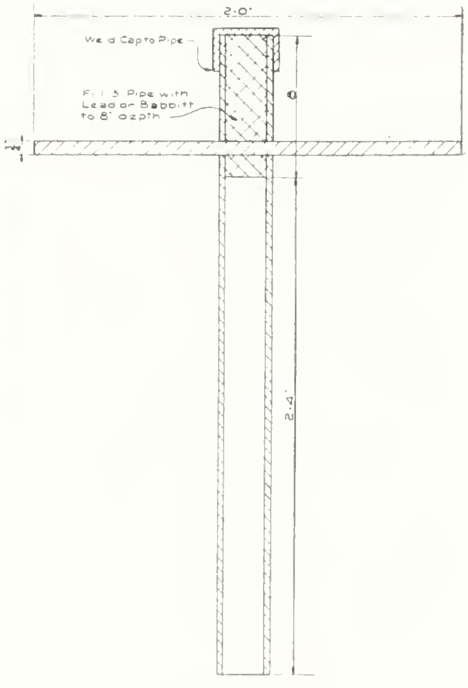


FIGURE NO. 2
Multiple Well Point Connection for Fairbanks Morse or similar type Pumps



Well Point Driver
Scale 1/4 = 1.0"

FIGURE NO 1

BILL OF MATERIALS

FOR FIGURE NO 2

3	2" Galv iron Street Elbows
10	2" x 4" Lg Galv Iron Pipe Nipples
1	2" Galv Iron Pipe Cross Fitting
3	2" x 1/4 Galv iron Pipe Reducer
3	2 Gate Valves
6	2 1/2" Hose Clamps
6	2 Swivel Couplings with Hose Spud (Female)
7	2 for 2" Pipe one End (Male)
15 FT	2" Suction Hose

FOR FIGURE NO 1

1 Pc	3 x 3.0 Lg iron Pipe
1	3" Pipe Cap
1	3/4 Dia x 2.0 Lg Steel Rod
25 LBS	Lead or Babbitt

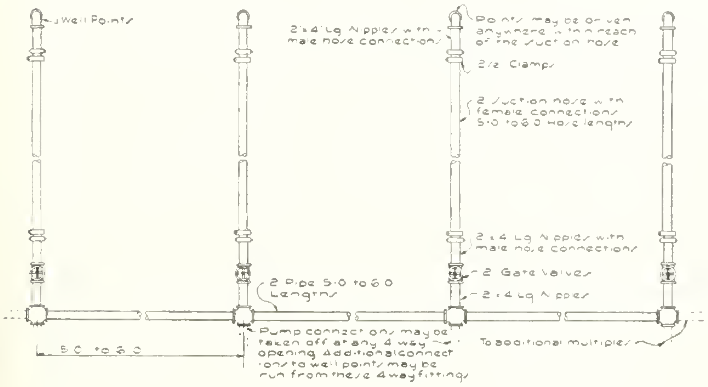

Well Points
2" x 4" Lg Nipples with male hose connections
Points may be driven anywhere within reach of the suction hose
2 1/2 Clamps
2 Suction hose with female connections 5.0 to 6.0 Hose lengths
2 x 4 Lg Nipples with male hose connections
2 Gate Valves
2 x 4 Lg Nipples
2 Pipe 5.0 to 6.0 Lengths
5.0 to 6.0
Pump connections may be taken off at any 4 way opening. Additional connections to well points may be run from these 4 way fittings
To additional multiples

FIGURE NO 3
Shows method of connecting multiple well points in series

Where flexible intake suction hose is used, it is not necessary to drive the well points in line. Also, it is not necessary that the pipes extend equal distances above the ground. The only requirement is that the distance between the points be within the limit to which the couplings and suction hose are cut and can be extended.

In driving individual points, a cone-shaped hole should be dug at the point of driving. Water can then be poured alongside the driven point to eliminate sucking of air when the pump is put in operation.

When a multiple unit is set up, all joints should be leaded. A bar of brown laundry soap will serve the same purpose in the field.

Use of a four-way coupling with nipples makes it possible to hook directly as shown in figure 2 of the illustration, the fourth connection being the pump intake. If gate valves are also used it is possible to cut out any or all well points. One point may then be put in use while another is being sunk, or a point which is sucking air may be cut out.

If T's are substituted for elbows directly on the take-off from any one individual point, an additional extension can be made to another point 8 or 10 feet distant.

From the point of take-off at the well point, 2-inch piping, couplings, and valves are used.

The four-way connection with valves attached may be set up with leaded joints as may also the 2-inch suction hose units with female swivel couplings attached. Elbows or T's with nipples attached may similarly be prepared in advance.

Upon driving the point it is merely necessary to attach the elbow with nipple and reducer attached. The suction hose with swivel couplings is then attached to the nipple, the other coupling being ready to attach to a four-way valve unit. As other points are sunk, they are in turn coupled to the four-way valve unit. The pump, also attached to the four-way valve unit, may be placed in operation as soon as sufficient points have been connected to furnish an adequate water supply. Points may be cut in or out at will by use of the valves.

As will be noted from a study of figure 2 in the sketch, two points may be anywhere up to about 12 feet apart, while the third may be about 6 feet to the rear of the center point of the line connecting the first two. This gives an ideal spacing. If more points are sunk, they may be extended beyond the first points to distances governed by equipment available, topography, etc. The flexibility of the intake hose permits selection of well-point locations as governed by physical features of the ground, rocks, stumps, etc. While the suction hose lengths of 5 feet, as shown in the sketch, together with couplings, increases the total length to around 6 feet, it is permissible to have somewhat longer or shorter connections. The lengths may be increased by 2 or 3 feet, but should not be shortened to less than 4 feet because of the difficulty in bending short lengths of suction hose.

Figure 3 of the illustration shows a method of hooking up multiple well points, using a main-line pipe and four-way couplings. It will be noted from a study of this sketch that points may be driven on either side of the main line, the only governing factor being the length of the suction hose couplings. Points may be placed all on one side of the main-line pipe, on both sides, or at selected points on either side. Similar latitude is allowed in the selection of the pump location, which may be at either end of the main-line pipe or at any one of the four-way connections. It will naturally be placed so as to be nearest the largest group of working points.

Flexibility is one advantage of the unit, and allows points to be sunk at almost any location. The units are designed in multiples which may be changed, added, or removed at will or cut off by use of gate valves or plugs. Four-way connections with valves attached should be kept intact and assembled at all times if possible. The suction hose with swivel couplings is very convenient, inasmuch as it can be quickly attached with the use of only a spanner wrench. Rubber washers eliminate the need of soap or white lead when attaching hose to the pipe or nipples.

Power Pump and Engine

Fast motors, cooled by circulating water from the intake, are not adaptable to this type of hook-up because of their high speed. Any great variation of water flowing through their cooling systems would soon cause them to burn out. Pacific marine or Evinrude motors are, therefore, not adaptable to this form of use. Instead a slower motor, with self-contained water cooling system is used.

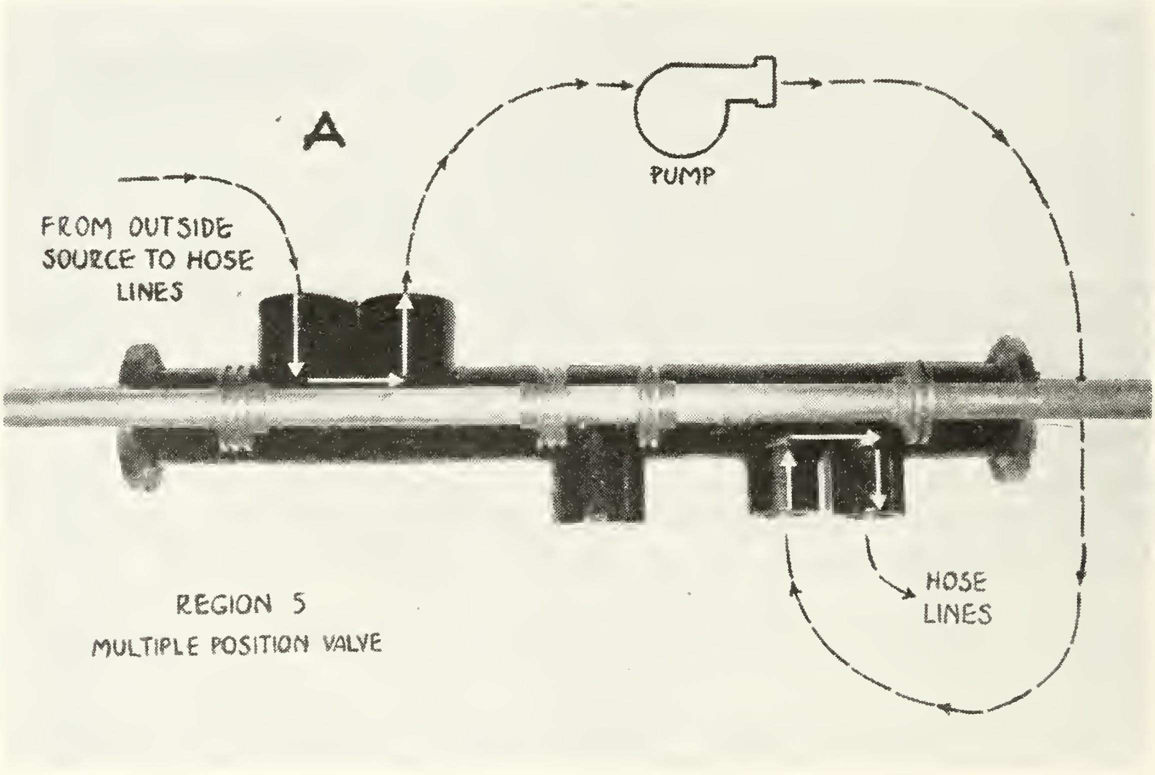
The Fairbanks-Morse type of pump with simple gasoline engine attached has been used very successfully. Other similar types of motors are doubtless available, although we have not had experience with them. The one used does not demand such a constant or heavy flow of water, and a temporary lag or halt in the water stream in no way harms the motor, which is cooled by its own water supply. The use of 2-inch intake suction hose for connectives between well points permits easy flexibility without buckling because of the vacuum created by the pump.

THE MULTIPLE-POSITION VALVE

F. W. Funke

Fire Equipment Specialist, Region 5, U. S. Forest Service

There has long been a definite need for a quicker and easier operating valve-control manifold for use on tank trucks, not so much because of the time element involved in operating a set of valves, but because of the value of simplicity in the use of such a device. The training of tank truck operators becomes much simpler when the various pumping system-control operations are reduced to a minimum, and the possibility of failure in critical situations because of complicated valve systems is greatly lessened.



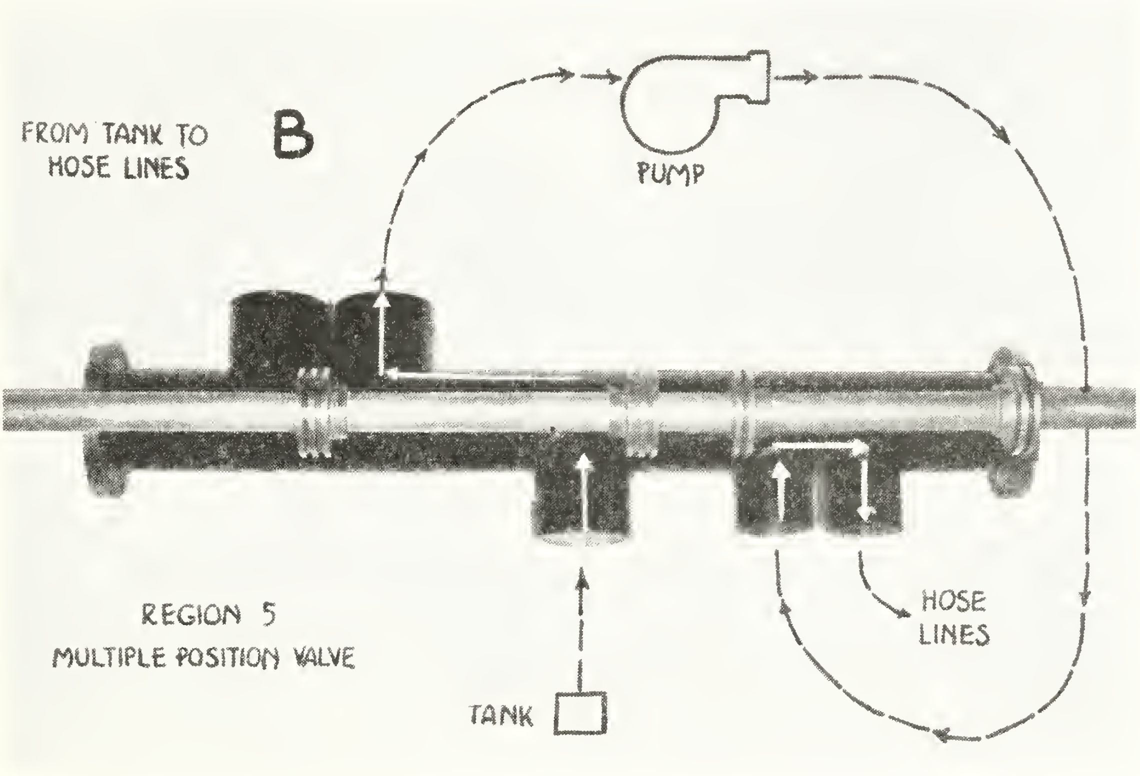
In order to introduce the necessary flexibility in a tank truck piping system, various control valves are required. Including the feature of drafting from either side of the tanker a minimum of five individually operated valves in units of this type are necessary for the delivery of water from an outside source to the hose lines, from an outside source to the tank, and from the tank to the hose lines.

Although gate valves are acceptable on the suction side of the pump, plug type valves must be used on the pressure side. Quality and size of this equipment make the cost rather high. The plug valves must have ample waterway area and be of the high-pressure type with a rating of not less than 350 pounds hydraulic.

Some development has occurred in multipurpose manifolds during the past decade. The State of California Division of Forestry developed a built-up pipe section bypass manifold to reduce piping requirements on various types of tank trucks. The Cleveland National Forest in Region 5 developed a three-way valve adapted from the Merco-Nordstrom valve and used it on a number of their tank trucks with success. While investigating the Cleveland development, looking toward its adoption as a regional standard tanker valve installation, certain remediable deficiencies became evident. The result of the investigation was the development of the multiple-position valve illustrated.

While the various valve and piping arrangements included in multipurpose installations have served a very definite purpose, practically all have included in their design various features which restrict their usefulness in tank-truck systems. Constricted waterways and a multiplicity of L's and bends are usual.

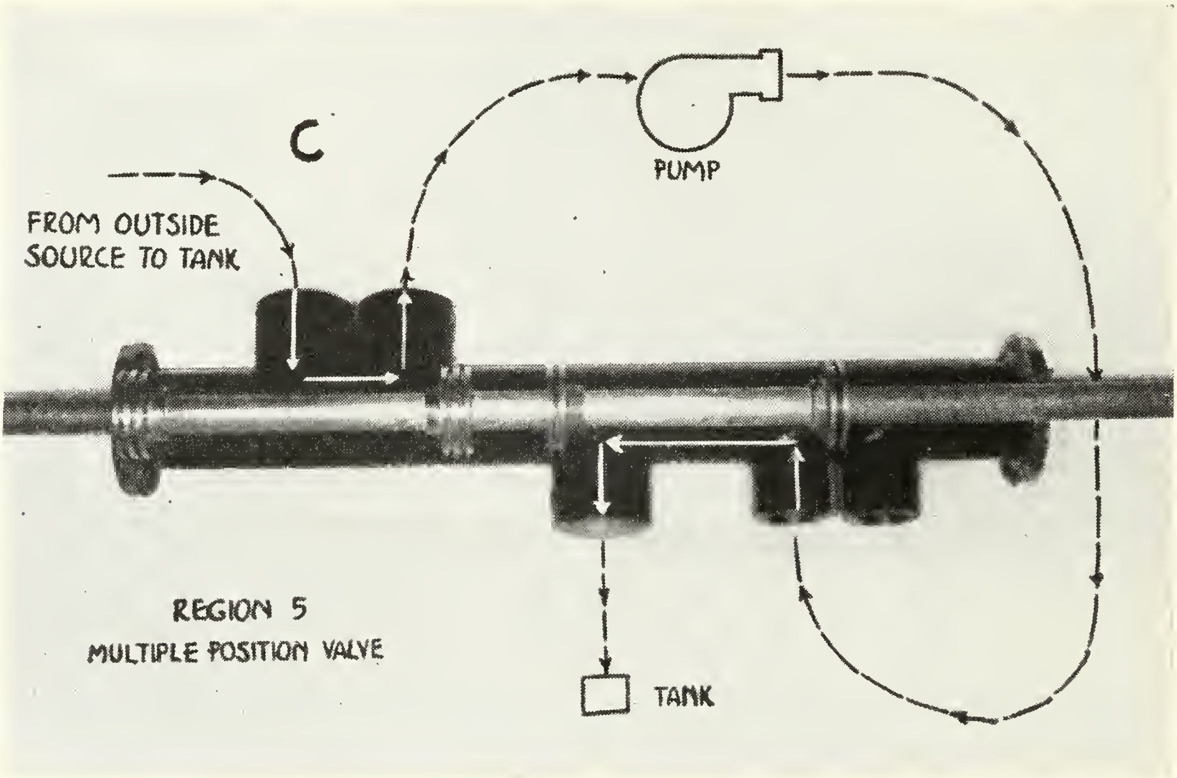
When the fact that a 1½-inch, 90-degree elbow is equivalent in friction loss to 8 feet of 1½-inch pipe is considered, it is easy to see where a relatively high loss can be introduced in the system unless care is used in laying out the pipe lines. Using the theoretical friction-loss factor of 0.11 pound per square foot for 1½-inch smooth iron pipe, it can be assumed that each 90-degree elbow will create 0.88 pound per square inch friction loss. It is obvious that much of the power of the pump can be wasted in the piping system unless care is used to reduce L's and returns to a minimum.



The development illustrated consists of a cast-brass valve body and a conventional piston and rod arrangement. As illustrated the piston valve has been superimposed on the valve body to indicate the arrangement and type of valve. The valve body consists of a tube having a 3-inch diameter bore with three 2½-inch openings and two 1½-inch openings. The piston valve consists of a length of 1¼-inch brass pipe, on which are suitably placed several pistons equipped with Monel-metal rings. The valve body contains webs over the various openings to hold the rings in place while passing over the orifices. Water seal and lubrication is provided through an alemite fitting attached to one end of the piston rod and outlet holes to the ring grooves. Flanges on the ends of the valve body proved a suitable means of mounting the casting for machining and later mounting in the truck chassis.

A, *B*, and *C* in the illustration show the relative position of the piston valve for the various operations. These should be quite clear from the schematic outline.

The unit assembly is mounted crosswise in the chassis and is operated either by means of a lever and segment, which provides for three stops indicating the position of the piston, or a hand wheel and screw attached to the piston rod which actuates the valve rod. A suitable indicator plate shows the position of the valve (not shown).



The device requires a valve body 34 inches long; the size of any particular unit is dependent upon the relative size of the openings and waterways.

The ends of the valve body should be packed after mounting with a small plate and a dustproof felt to prevent road dust from entering the bearing surfaces.

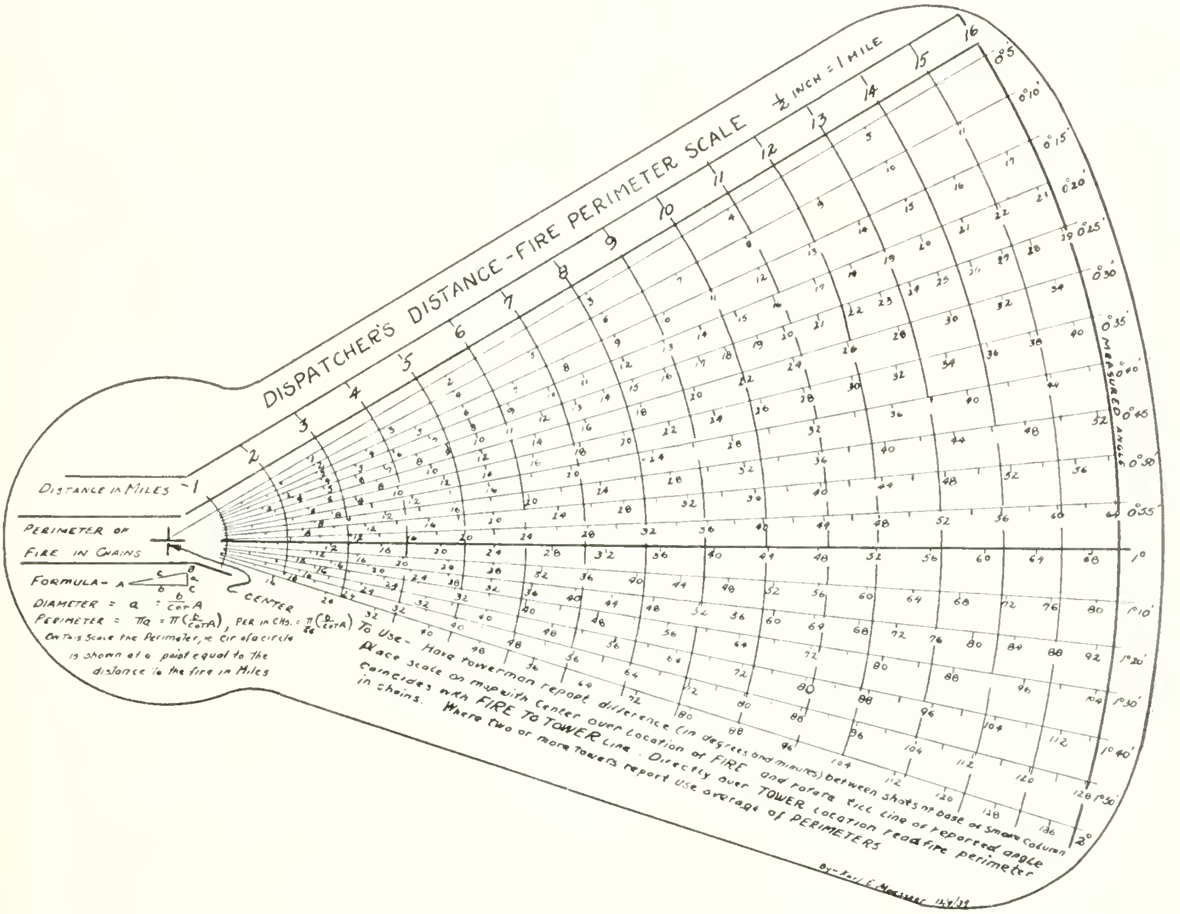
Shop detail blueprints of the device may be obtained by addressing the Regional Forester, United States Forest Service, Phelan Building, San Francisco, Calif. United States Forest Service agencies may make arrangement with the supply depot for purchase of the device. Such units will be furnished with unfinished piston rod ends, which can be cut to the individual installation.

A DISPATCHER'S DISTANCE-FIRE PERIMETER SCALE

KARL E. MOESSNER, *Junior Forester, Upper Michigan National Forest, Region 9, U. S. Forest Service*

A dispatcher, mobilizing his forces in the heat of an emergency; an nspector analyst, carefully reviewing the action on an extra-period ire; a research worker, attempting to determine the rate of spread 'or a given fuel type, all are vitally interested in the size of fires when irst discovered by the lookout.

A glance at the fire reports serves to convince the most optimistic ndividual that our present methods of estimating the initial size of



FORMULA–

DIAMETER = $a = \frac{b}{\cot A}$

PERIMETER = $\pi a = \pi\left(\frac{b}{\cot A}\right)$, PER in CHS. = $\frac{\pi}{66}\left(\frac{b}{\cot A}\right)$

On this Scale the Perimeter, i.e. Cir of a circle is shown at a point equal to the distance to the fire in Miles

To Use– Have towerman report difference (in degrees and minutes) between shots at base of smoke column. Place scale on map with Center over Location of FIRE and rotate till line of reported angle coincides with FIRE TO TOWER Line. Directly over TOWER Location read fire perimeter in chains. Where two or more towers report use average of PERIMETERS

By– Karl E. Moessner 12/9/32

Distance fire-perimeter scale.

ires are, to say the least, extremely inconsistent. On some forests he measurement of the smoke column by means of mil-scale glasses ıas tended to improve these estimates, but in most cases the personal pinion of the lookout, backed occasionally by a rule of thumb, has een entered on the reports without check or question.

It is undoubtedly true that an experienced lookout can estimate the ize of a fire observed in seen area close to his tower within an allowable limit of error. It is also true that any lookout equipped with ire finder can measure the width of the smoke column, assume a liameter of 90 feet to the mile per degree, multiply the resulting figure y 3.1416, divide by the number of feet in a chain, and arrive eventually at an estimate of the perimeter of the fire.

The lookout can do this, but does he? The figures on our fire eports would seem to indicate that he does not.

The dispatcher's distance-fire perimeter scale illustrated is offered as a means of standardizing the estimates of initial fire perimeters, in order to aid both dispatching and analyzing. It is constructed on transparent plastacel, with a glass-topped pin fixed at the point marked center. It consists of:

1. A distance scale graduated in miles and identical to the scale of the dispatcher's azimuth map (½ inch=1 mile, where this scale map is used).

2. A number of scales placed below this, but radiating from a common center, and graduated in chains of perimeter for fires located at varying distances from the observer, and with smoke columns subtended by angles of 5-minute variation.

We find, then, that a fire 9 miles distant, with a smoke column subtending an angle of 20 minutes would have approximately 13 chains perimeter, if of circular form.[1]

In constructing this scale, the following formula is used:

$$\frac{\Pi}{C}\times\frac{b}{\cot A}$$

$\Pi=3.1416$, the circular constant.
$C=66$, the number of feet in a chain.
$b=$the map distance from tower to the fire.
$\cot A=$cotangent of the angle subtended by the smoke column.

In using this scale, the dispatcher:

1. Secures from the lookouts the normal azimuth readings, and the angle subtended by the smoke column, measured to the nearest 5 minutes.

2. Plots the cross shots in the usual way. He then sticks the perimeter scale center pin at the map location of the fire, rotates the scale until the line of the angle read intersects the map location of the tower.

3. Directly below this point he reads the perimeter of the fire in chains.

4. When smoke column readings are obtained from two or more lookouts, the same procedure is followed, except that the final perimeters are averaged.

Where a glass-topped table is used by the dispatcher, it will be found advisable to make up the perimeter scale with a center pin the same size as the protractor. The scale is then used by placing the center pin in a tower hole and rotating it until the angle line intersects the map location of the fire. It will be noted, however, that where two towers submit readings, this method of using the scale requires two set-ups against one for the system previously mentioned.

While it is realized that this scale will not prove absolutely accurate in all cases, it is believed that by concentrating the responsibility for the estimation in the hands of the dispatcher, and furnishing him a tool for the job, much inconsistency in the records will be eliminated.

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[1] Records show that most fires in their early stages are circular or oval, tending to become irregular as they increase in size.

MODIFICATIONS OF THE CALIFORNIA PROFILING BOARD

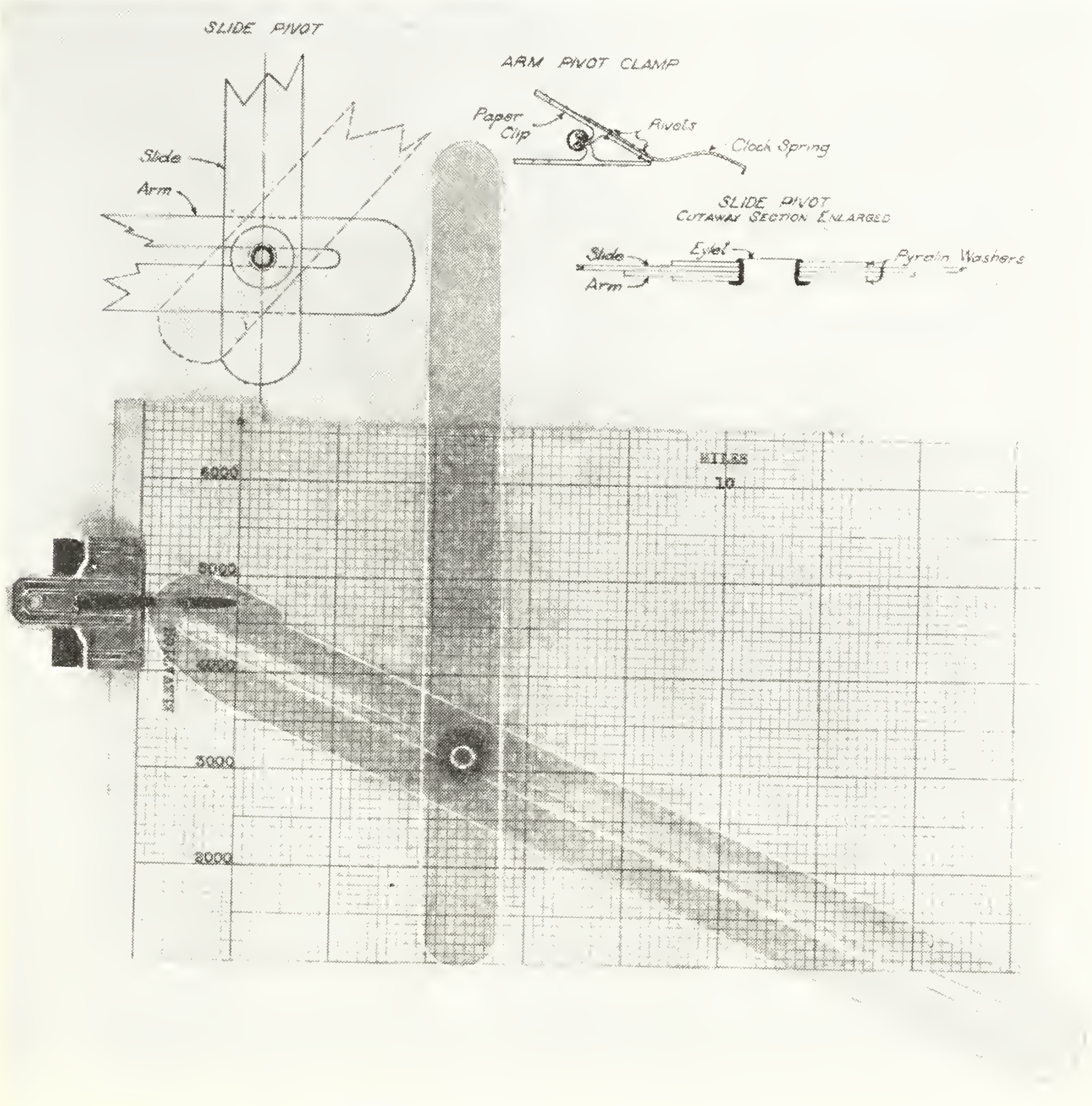
Brooke R. Davis

Junior Forester, Cherokee National Forest

The modifications of the California Profiling Board [2] herein described and illustrated consist of an arm-pivot clamp and a slide secured to the arm by means of a movable pivot.

When two points, differing but 50 or 100 feet in elevation, are to be mapped with the profiling board, it is often difficult to pierce the board at the exact elevation desired without breaking over into a previously used arm pivot hole. The arm-pivot clamp is not only very easily and quickly placed on the exact point desired, but also obviates the necessity of piercing holes in the profiling board.

To make an arm-pivot clamp, flatten the sides of a number 10 Esterbrook paper clip; then rivet a small section of clock spring or other resilient metal to the side of the clip, as indicated in the diagram.



Arm-pivot clamp and slide pivot for profiling board.

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[2] Described p. 7, U. S. Department of Agriculture Circular No. 449, "Planning, Constructing, and Operating, Forest-fire Lookout Systems in California", by Show, Kotok, Gowen, Curry, and Brown.

The parts of a pivoted slide are all made of pyralin and of any size that is best suited to the scale of the map in use. Before crimping the eyelet with eyelet pliers, it is suggested that a piece of paper be inserted on the inside of each washer and then removed after the eyelet has been crimped, thus insuring ample clearance to allow for freedom of movement of the pivot on the arm.

For accuracy, efficiency, and ease in profiling, some form of perpendicular slide is obviously necessary. The pivoted slide described has proved to be exceptionally convenient to handle and of very material aid.

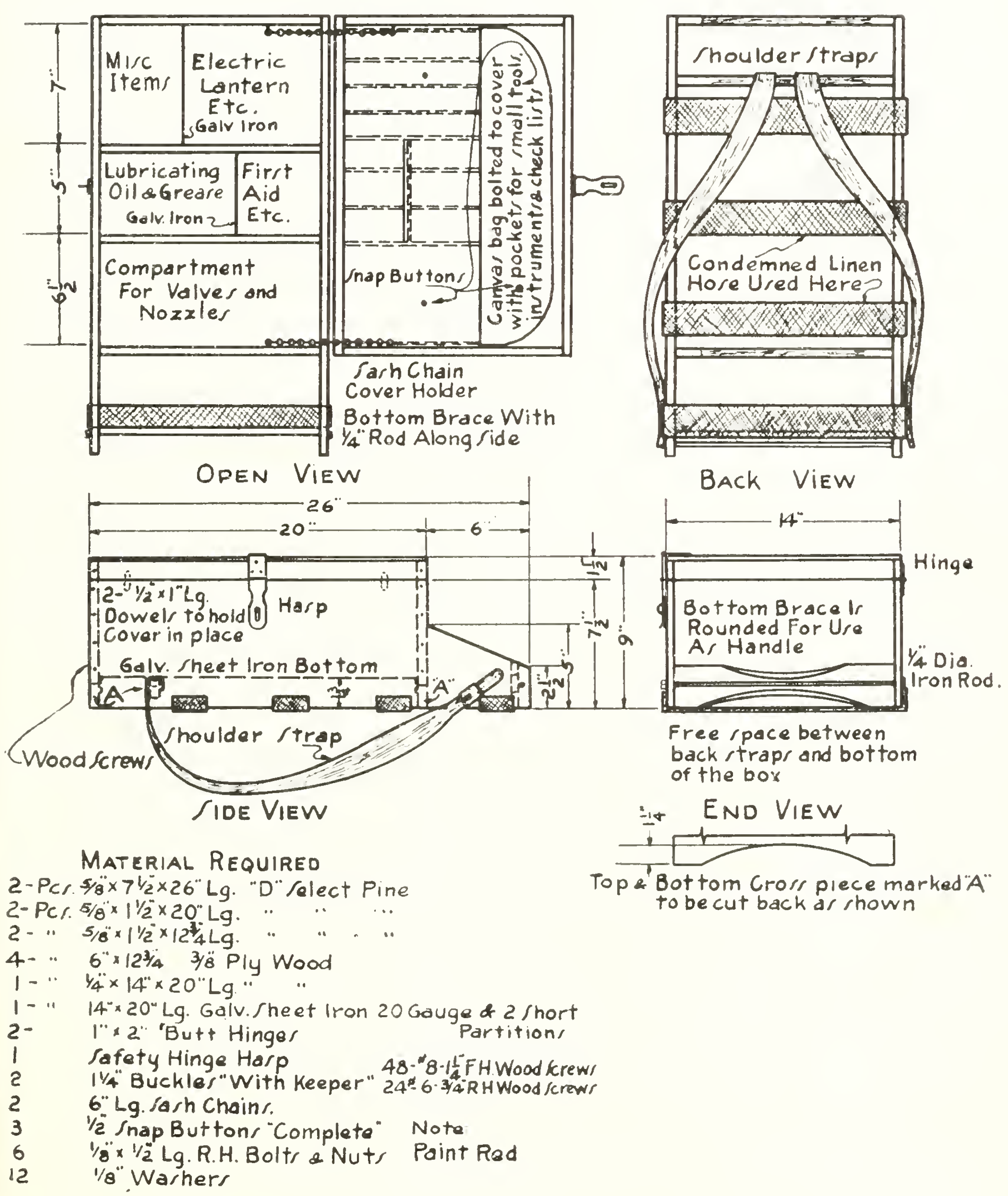
POWER PUMP ACCESSORY BOX

R. G. SETTERGREN

Superior National Forest, Region 9, U. S. Forest Service

The need for an accessory box for the power pumps on the Superior National Forest has long been felt. The packsack was formerly used for the accessories and tools, but was not very satisfactory as the equipment was always in disorder, making it necessary to remove

POWER PUMP ACCESSORY BOX
WITH BUILT IN PACKFRAME


7"
5"
6½"
Misc Items
Electric Lantern Etc.
Galv Iron
Lubricating Oil & Grease
Galv. Iron
First Aid Etc.
Compartment For Valves and Nozzles
Snap Buttons
Canvas bag bolted to cover with pockets for small tools, instruments & check lists
Sash Chain Cover Holder
Bottom Brace With ¼" Rod Along Side
OPEN VIEW
Shoulder Straps
Condemned Linen Hose Used Here
BACK VIEW
26"
20"
6"
12-⅝" ½ × 1" Lg. Dowels to hold Cover in place
Harp
Galv. Sheet Iron Bottom
"A"
"A"
Wood Screws
Shoulder Strap
1½
7½"
9"
5"
2½"
SIDE VIEW
14"
Hinge
Bottom Brace Is Rounded For Use As Handle
¼" Dia. Iron Rod.
Free space between back straps and bottom of the box
END VIEW
1¼
Top & Bottom Cross piece marked "A" to be cut back as shown

MATERIAL REQUIRED

2-Pcs. ⅝ × 7½ × 26" Lg. "D" Select Pine
2-Pcs. ⅝" × 1½" × 20" Lg. " " "
2- " ⅝" × 1½" × 12¾ Lg. " " "
4- " 6" × 12¾ ⅜" Ply Wood
1- " ¼" × 14" × 20" Lg. " "
1- " 14" × 20" Lg. Galv. Sheet Iron 20 Gauge & 2 Short Partitions
2- 1" × 2" Butt Hinges
1 Safety Hinge Hasp
2 1¼" Buckles "With Keeper"
2 6" Lg. Sash Chains.
3 ½ Snap Buttons "Complete"
6 ⅛" × ½" Lg. R.H. Bolts & Nuts
12 ⅛" Washers

48-#8-1¼" F.H. Wood Screws
24-#6-¾" R.H. Wood Screws

Note
Paint Red

nearly everything in order to find what was wanted. Usually after every fire there was loss of tools and damage to the accessories because of the method of packing and lack of accountability.

During the last 2 years I have seen several types of accessory boxes and have made two or three of my own, but none of these boxes has proved entirely satisfactory. We have now developed, with the aid and suggestions of the supervisor and regional office, a combination accessory box and pack frame. We believe this will be entirely satisfactory for proper packing of accessories and tools, inasmuch as partitions in the box and canvas tool kit will keep all equipment in an orderly manner, readily accessible, and easily accountable, as each piece of equipment has a designated place.

The box weighs 16 pounds when constructed as shown on the accompanying sketch. The sides and ends are made of "D" select pine finished to ⅝-inch thickness and 8 inches wide. The bottom of the box is made of 28-gage galvanized iron recessed 2 inches to give clearance for the back in packing. The cover and two partitions in the box are made of 3-ply, ⅜-inch plywood with the short partition of 20-gage galvanized iron. The galvanized iron partitions are readily removable as they are slotted in by making a cut with a hack saw about 3/16 of an inch deep. The box is put together entirely with screws, using 1½-inch No. 8 flat-head screws for the box and ⅝-inch No. 8 screws for the cover. The two plywood partitions are nailed in as is the bottom, cleats being used to recess the bottom.

The size of the box itself is 14 by 20 inches, outside measurements, but it was necessary to extend the two side boards 6 inches in order to get ample length on the pack frame. The sketch shows that one end and the brace between the two tailpieces are rounded 1½ inches in order to give back clearance. The brace is rounded on the top for a hand grip while moving around in the warehouse. This is further strengthened by a ¼-inch rod, as shown in the sketch, so the brace will not have a tendency to pull out when the box is carried in the hand.

The tool kit is made of 12-ounce duck, slots sewn for each individual tool, a flap covering the tools, either tied or snapped to hold the tools in place while in transit. This kit is firmly bolted to the cover by six stove bolts.

Condemned 1½-inch linen fire hose tautly stretched and firmly secured with ⅝-inch screws makes a very acceptable back support on the pack frame. Four pieces of this hose spaced 3 inches apart are sufficient, as it is not necessary to have any on the top, as the frame does not rest on the back. The shoulder straps are made of 2-inch webbing secured 6 inches from the top of the frame with leather straps and buckle, for adjustment at the bottom.

One important feature in the design of the box and the attachment of the carrying straps was to get the correct balance to give ease in carrying. After several trials and tests it was found that the load (or box of tools) should be set so it will rest high on the frame when carried. This accounts for the peculiar shape and design of the unit

The accessories for the power pumps possibly vary between forests and regions, but we have tried to limit the accessories and tools to a minimum so as to reduce weight. The total weight of the accessory box fully equipped is 60 pounds. Following is a list of tools we feel are needed and which can be packed in the box:

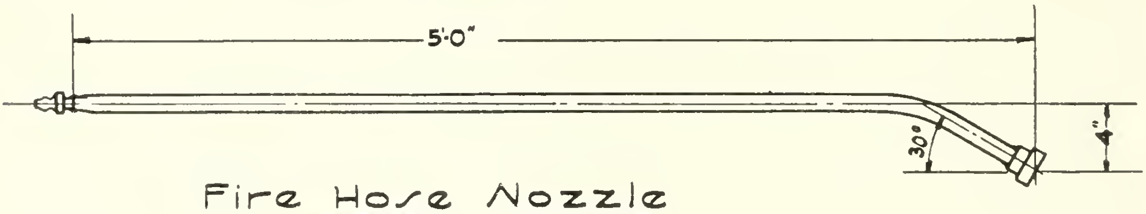
1 cost operation book.
1 crescent wrench.
1 electric lantern.
1 funnel, filtering.
1 file, magneto.
1 first-aid packet SDO.
1 gas-line hose, flexible rubber.
1 grease cup, 1-pound can.
20 hose gaskets.
1 instruction for operation.
1 lubricating oil, in 1-quart can with inverted spout.
2 nozzles.
1 pencil.
1 packing nut wrench.
1 pliers, 6-inch auto.
1 pack cover, canvas, 3 by 3 feet.
1 screw driver, 4-inch.
3 spanner wrenches.
2 spark plugs, extra.
2 Siamese valve couplings.
1 suction hose (strapped on outside of box).
1 suction hose strainer.
2 starting cords.
1 stovepipe wire (small coil).
4 car seals.
1 wiping rag (bundle).
1 copy list of contents.

The list will fit into the pocket on cover or can be tacked on the cover if preferred.

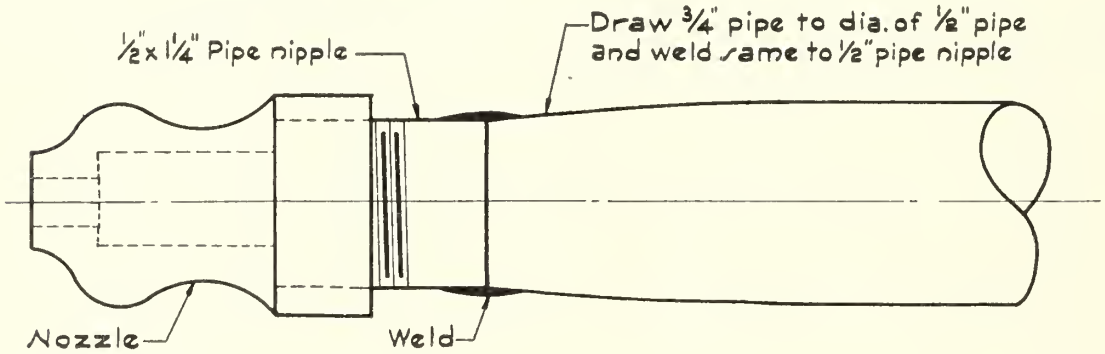
LONG FIRE-HOSE NOZZLE

Ottawa National Forest, Region 9, U. S. Forest Service

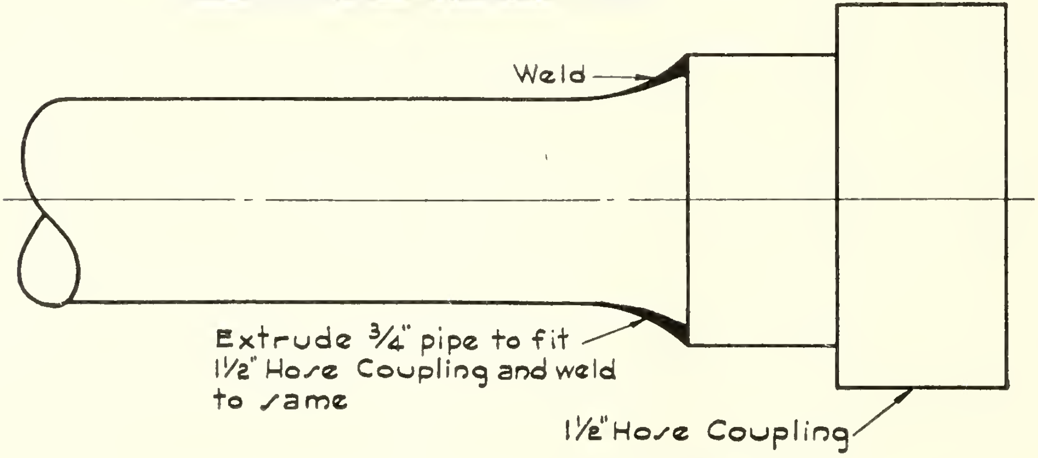
The accompanying illustration shows a long fire-hose nozzle for use with 1½-inch hose. This nozzle has proved very valuable for use on deep burning peat fires or for mop up of fires in roots or other deep materials. It was developed by members of the Minnesota State Division of Forestry, and several forests in Region 9 have adopted it as part of their pumper equipment.



Fire Hose Nozzle


½"x1¼" Pipe nipple
Draw ¾" pipe to dia. of ½" pipe and weld same to ½" pipe nipple
Nozzle
Weld

Detail of Nozzle End



Detail of Coupling End

Interchangeable ¼" or 5/16" nozzle tips as mfg. by Pacific Marine Supply Co. Seattle Washington.
Design of Fire Hose Nozzle by State of Minnesota

Volume 3 Number 3

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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ADAPTING THE CONFERENCE TO FIRE CONTROL TRAINING

R. C. LINDBERG

Training Supervisor, Region 6, U. S. Forest Service

It is true, as the author says, that contributions on training have been very limited. This is a reflection of lack of balance in fire-control thinking and practice. One of our acute needs is to build up the body of understanding, skills, and practice and bring training up to the relative level of advancement attained in aerial delivery of supplies or construction of detection improvements, for example. The author takes up one training device which we have used with more enthusiasm than judgment. If his article provokes others challenging accepted practice or reporting suggestive experience in training for fire control, this vital activity may begin to catch up.

Possibly "more line has been lost" in use of the conference than in ther training methods.

Some 20 years ago inquiring minds recognized the potential training alue of the conference, analyzed its pattern of procedure, and for- ulated what might be considered a set of rules for conducting a onference. Forest officers have used the conference method to some xtent for the last few years in connection with guard training and ith overhead in suppression training. Results have varied from ighly satisfactory to a total loss.

So the questions: What are the more common criticisms of the con- erence as it has been used in fire-control training? What are the nderlying reasons contributing to unsatisfactory results? What daptation can or has been made to increase its efficiency as a training ool?

The enumeration of the following criticisms, it should be clearly nderstood, is not a blanket indictment of all past conference training, ut rather a necessary step in seeking ways for improvement:

1. Some conferences do not begin anywhere, go anywhere, or end nywhere.
2. The procedure is too time-consuming.
3. Conferees lack experience in or knowledge of the subject in which raining is intended.
4. The conference leader puts a question on the board; after which e frantically attempts to record everything that is said. No sum- arization is made. It ends, leaving the question, "So what?" in he minds of trainees.
5. The leader does most of the talking.

Certain key reasons must be more or less responsible for all of the riticisms listed. Personal experience and observation indicate there re three reasons of major importance:

(*a*) Lack of training and experience in conducting a conference.

It is difficult to determine just when and where and how the con- erence method of training was chosen and first used in fire-control training. It seemed applicable for certain training situations, and in the course of time instructions for conducting a conference appeared in training handbooks. But, as a rule, conference leaders in fireguard or suppression training have not received any great amount of training in either planning or conducting a conference. As the time for the guard-training camp approaches, instruction assignments are made. Certain instructors are faced with leading a conference. One type, the optimist, says, "It's a cinch." He makes no preparation. Refer to criticisms 1, 2, 4, and 5 for the probable outcome. The second type, very conscientious, makes a plan for his conference so rigid that no alternatives are considered or tolerated. He finds that conferees do not react the way they were supposed to, nor say what the plan calls for. Refer to criticisms 2 and 5 for the probable outcome. The third type comes through and does a pretty good job, and it is said that he has natural ability.

(*b*) The conference leader, both in planning and execution, is more concerned with conference technique than training objective.

Forest officers want to do things right. They want to lead a conference properly. With limited training and experience they are, in some respects, in the same fix as the student flyer taking his first few lessons. He is so occupied with the mechanics of flying the ship, "keeping the nose on the horizon and the wings level," that he loses all sense of direction and destination. With continued instruction and practice, conscious attention given to controlling the ship decreases and proportionate time is gained for selecting route of travel and destination.

The thinking of the forest officer leading his first few conferences is probably along this channel: "I have to lead a conference"—his preparation; "I am going to lead a conference"—his performance; "I am leading a conference." All of this submerges the principal idea, "I have a training job to do and I will make use of the conference in attaining my objective." Instruction and supervised practice are partly the answer, but a clearer perception of objective is needed, which leads to the final reason for criticisms of the conference method of training.

(*c*) The lack of a tangible objective for training in such subjects as fire prevention, the duties of a foreman or fire-camp manager, and strategy as applied to fire suppression.

Training of this type differs from training in how to use a shovel or an axe in that it is, for the most part, mental training. In practice, it involves sizing up situations (analysis), planning, and action.

A safe approach in training is to begin with the premise that thought precedes action, and that day-to-day action is governed more than is realized by *past experiences*. Where an individual's own experience is lacking or limited, he turns to someone who has had the experience which he believes will be helpful. A logical conclusion is that the decisions made, the action taken in any given situation, will be correct in proportion to past experiences in similar situations. Where experience is lacking, the most valuable guide to correct action is lacking.

A tangible objective for training, then, may be simply to design training situations which will provide the learner with simulated real experiences which he can use as a guide to correct action in the performance of his job.

In such an approach to training it is evident that the most careful consideration will have to be given to plans and physical preparation. The measuring stick for effectiveness of training can be easily applied: Is the learner being given experience in analyzing problems, sizing up situations, making observations, reaching conclusions, making decisions, taking action in circumstances which approach the actual as nearly as possible?

The conference method has a useful place in a training program designed to simulate real experience, but it must be used only as a training device—as the occasion demands, dropped for some other method, and used again. There is great need to break away from the stereotyped manner of conducting a conference. There is greater need for making the training situation more realistic. In this connection, it is possible to make use of sketches, relief maps, enlarged aerial photographs, moving pictures, models, cases, problems, and field demonstrations. The use of these devices, of course, takes preparation, but of what value is a training program that does not get results?

The following illustrations have been designed to show how a program simulating real experiences might be carried out:

On the subject of fire prevention.—Planning begins with an analysis of the situation. Certain facts are known, such as: Over one-half of all fires are man caused—by different types of people, and for different reasons. Further analysis determines types and reasons. The problem is to find a hub to which the spokes of a prevention program can be anchored. It is a trait of human nature to consider any proposition in terms of, "How is this going to affect me"? To be successful, the fire-prevention program must in some way sell a *gain*, rather than a *loss*, in personal advantage.

The objective of training is to give forest officers a background of experience in (1) analyzing and classifying prevention problems, (2) finding solutions which offer a gain in *personal advantage* to individuals or classes of people, and (3) the salesmanship to put it over. Preparation for group training to reach this objective will include assembling a variety of *cases* (real or hypothetical), *problems*, *solutions*, and method of *transmittal*.[1] The conference method can be used in group analysis of problems, examining given solutions of problems, analyzing proposed solutions of problems, and proposed method of transmittal by individuals of the group. During this training process, the conference would simply serve as a device to guide and stimulate thinking toward the right answer. Advance assembly of material as suggested saves time, otherwise frequently wasted, in focusing group attention on a specific problem. Most important, it leaves in the minds of the group a feeling of having participated in what amounts to an actual experience.

Foremen play an important part in the fire-suppression job. They direct the work of from 25 to 50, or more, fire fighters. All have observed, or perhaps conducted, foreman-training conferences where the instructor placed on the board this question: "What is the foreman's job?" Duties were listed and maybe their relative importance discussed. Such procedure would be all right as a starting point in foreman training, but too often that is all there is to it. In terms of experience on which the foreman can draw in actual practice, there is almost nothing.

---

[1] Transmittal means the manner in which the idea is conveyed, such as through personal contact, addressing a group, printed material, pamphlets, posters, etc.

There are ways of doing a better training job. For example, the formen is concerned with "fire-line location" and "adequacy of fire line." Instead of talking about it, why not in advance of training build a piece of fire line in relation to a plainly marked hypothetical fire boundary and, for instruction purposes, stake it off in 100-foot units. Careful planning would make possible incorporation of both good and bad practice in location and construction of the line.

Instead of discussing line construction in the conference room, the instructor would take the foremen class over one unit of the demonstration line, at which time he would point out and give supporting reasons for good and bad practice. The class, working individually, would then inspect a unit of line and make brief notes. Later the instructor and the group as a whole would go back over the unit and discuss location and adequacy of fire line, point by point. In so doing, the instructor would in an informal way use the conference method in drawing out reasons, in promoting analytical thinking, in arriving at correct conclusions as to good practice. The procedure would be repeated for the next unit of demonstration line, and so on. The instructor's objective would be to develop the foreman's ability to size up and analyze situations, to arrive at sound decisions as to good practice; and, in effect, provide the foremen with a background of experience which would be vivid enough to be retained and which consciously or unconsciously would guide each individual in future actual situations. Training in certain other phases of the foreman's job could be handled similarly.

Fire-camp managers (*camp bosses*) are sometimes responsible for selecting the specific location of the fire camp, but are always responsible for laying it out. Again, instead of talking about these duties, and calling it training, would it not be better to get out in the field and do something about it? To illustrate: The instructor would take his group, who are to receive training as camp managers, to a previously determined location where he would describe the boundaries of a supposed fire and explain certain guiding principles on camp location and the reasons for each. Then he would take his group to two or three possible locations for a fire camp. Locations would be discussed on the ground, and conclusions reached as to the strong and weak points of each. During the discussion the instructor would use conference procedure in clinching fundamental principles on fire-camp location.

The same plan could be followed during instruction in fire-camp lay-out (the relation between location of kitchen, storage of supplies, truck yard, tool dump, bedding-down grounds), starting with the inspection of a previously laid out fire camp which would demonstrate good and bad practice. During and following such inspection the instructor would explain certain basic principles in fire-camp lay-out. To give the trainees experience, they in turn would be given the job of staking out additional camp lay-outs; after which their work would be inspected by the group as a whole under the guidance of the instructor.

Fire-suppression strategy training becomes increasingly important as the number of large fires decreases through improved fire-control echnique. As in the Army and the Navy, pseudo experiences will ave to be substituted for actual experience. In this training is imited to slash disposal for actual practice with fire behavior.

The critical review of action taken on past fires is a valuable training nedium. The conference method can be used to good advantage n such reviews. Time will be saved if good sketches of the day-to-day naps of the fire under discussion are prepared in advance; likewise y having individual copies of memoranda outlining action taken on he fire and other pertinent data.

Greater use of enlarged aerial photographs, relief maps, or carefully repared sketches will make problems more realistic and help each ndividual in the class to see them in the same light. Conference rocedure can be used to promote analytical thinking by drawing ut all angles of the problem involved and to crystalize conclusions s to fundamentals of sound fire-suppression practice.

The illustrations given attempt to show how the conference may be etter used as an aid in training, wherein *emphasis will be placed on eaching the objective of training* rather than on the method. With dequate carefully planned preparation for each training job, the ime consumed in training will be decreased and the desired results btained.

And finally in all the planning and preparation this question should e kept in mind: Will the training proposed leave the trainee with xperiences on which he can draw as a guide to proper action in the ob he is going to do?

It Can Happen Here and There.—The 323-acre Sibley Creek fire on the Mount aker National Forest was one of those fires where everything seemed to click nd no suggestions are made for improved action. The days this fire was burning ere extremely hot, temperatures of 110° were reached with a minimum of 15 ercent humidity. The one-lick method was employed, resulting in fast corral.

In estimating the manpower for first-period control, provision for relief crews as delayed with the result that men used in initial attack were greatly overorked. The one-lick crew started at 4 a. m. and established corral at 10 a. m., ut since no reserves were on hand, this same crew maintained control until 6 . m., when relief crews arrived. While they were successful, it might easily have esulted in a serious situation from attempting to hold line with a weary crew. n calculating probabilities, serious consideration should be given to the employent of reserves to relieve the corral crew when they have achieved corral, but re too exhausted to continue. The present formula for making calculations does ot specifically provide for this situation.—C. C. McGuire, acting supervisor, ount Baker National Forest.

A New Reason for Man-Caused Fires.—The Hospital Rock fire on the Modoc ational Forest was started about 4 a. m. by ranchers attempting to prevent rost damage to grain crops. The smudges they had prepared apparently did not ake enough smoke, so they set a large number of fires in dry grass where they pread to national-forest and national-park land.

LARGER FIRES ON THE NATIONAL FORESTS

Roy Headley

Division of Fire Control, U. S. Forest Service, Washington, D. C.

Among fire control men there is a real difference of opinion on the extent to which study should be concentrated on the larger fires as distinguished from all fires. Some men believe that by concentrating on the lessons to be learned from the relatively small number of fires which can be designated as "larger," much may be discovered which is likely to be missed by systems of analysis and study which include all fires. Others believe that concentration of attention on large fires is dangerous and may result in neglect of the methods and principles which are of importance in keeping small fires from becoming larger.

As is so often the case in such issues, the answer is probably a matter of proper balance. Both classes should be studied. Failure to review the action taken on even the smallest fires invites weaknesses that will let more little ones grow into big ones. But larger fires have characteristics peculiar to themselves. Management of the larger fire jobs is a rather distinct branch of fire control—and a backward branch. Failure to study the action on these larger fires invites weakness that will let big ones grow into bigger ones. These bigger ones hurt, too. Out of a total of 219,000 acres burned in 1938, 35,000 acres were lost in one fire. Seventy-five thousand acres were lost in the four largest fires.

Table 1.—*Number of larger fires and area burned by them inside national-forest boundaries*

	R-1	R-5	R-6	R-2	R-3	R-4	R-7	R-8	R-9	Total or average
Number of larger fires:										
1936	11	21	4	5	3	1	3	29	28	105
1937	4	11	7	2	1	3	1	20	13	62
1938	3	19	13	1	4	1	1	25	6	73
Average	6	17	8	3	3	2	2	25	16	80
Percent larger fires are of total fires:										
1936	0.6	1.2	0.3	1.2	0.2	0.1	0.4	0.7	0.7	0.6
1937	.3	.7	.5	.6	.1	.3	.3	1.1	.7	5
1938	.2	1.1	.6	.3	.3	.2	.3	1.0	.2	.5
Unweighted average	.4	1.0	.5	.7	.2	.2	.3	.9	.5	.5
Area burned by larger fires:										
1936	41,924	68,842	3,504	15,227	2,583	1,600	2,673	26,616	71,695	234,664
1937	1,474	12,487	4,548	2,435	410	4,048	785	13,386	8,178	47,751
1938	1,319	60,879	60,395	664	3,810	900	473	15,835	2,286	146,561
Average	14,906	47,403	22,616	6,109	2,266	2,163	1,310	18,612	27,366	142,992
Percent area burned by larger fires is of total area burned by all fires:										
1936	90.4	88.0	39.3	94.7	47.9	38.7	84.0	18.8	26.8	58.7
1937	42.4	75.9	81.8	83.4	21.0	66.6	20.5	36.5	35.8	51.5
1938	50.8	92.3	92.9	51.8	62.8	47.7	12.6	33.9	8.9	50.4
Unweighted average	61.2	85.4	71.3	76.6	43.9	51.0	39.0	29.7	23.6	55.3

Special reports are now available on larger fires for 3 years—1936, 1937, and 1938. Unfortunately, these reports cover fires of over *500 acres* for 1936 and fires over *300 acres* for 1937 and 1938. To avoid annoying repetitions of this difference in the following pages, the distinction is ignored and the term "larger fires" is used for both those over 500 acres in 1936 and those over 300 acres in the 2 following years. This fault should be kept in mind in reading the figures.

It is of some interest to note that of the total of 73 fires over 300 acres in 1938, 28 were between 300 and 501 acres. Seventeen of these were in the 3 eastern regions. In 1937, with a total of 62 fires over 300 acres, 23 were between 300 and 501 acres. Sixteen of these were n the 3 eastern regions.

TABLE 2.—*Averages of size, perimeter, output of held line, discovery time, and travel time for larger fires*

While averages usually mean little by themselves, they sometimes disclose trends and major variations reliably]

	R-1	R-5	R-6	R-2	R-3	R-4	R-7	R-8	R-9	Unweighted average or total
Average size of fires (acres):										
1936	3, 811	3, 278	876	3, 045	861	1, 600	891	918	2, 561	1, 982
1937	369	1, 135	650	1, 218	360	1, 349	785	669	629	796
1938	440	3, 204	4, 641	664	953	900	473	633	381	1, 365
Average	1, 540	2, 539	2, 056	1, 642	725	1, 263	716	740	1, 190	1, 361
Average perimeter of fires (chains):										
1936	1, 426	1, 163	1, 190	1, 240	467	560	633	594	1, 277	950
1937	451	710	503	928	283	1, 187	518	481	535	622
1938	600	807	1, 519	776	563	520	295	633	372	676
Average	826	893	1, 071	981	438	756	482	428	728	749
Total of perimeters of all larger fires (miles):										
1936	196. 0	305. 4	59. 5	77. 5	18. 3	7. 0	23. 8	215. 4	446. 9	1, 349. 8
1937	22. 6	97. 6	44. 0	23. 2	3. 5	44. 5	6. 5	120. 3	87. 0	449. 2
1938	22. 5	191. 7	246. 9	9. 7	28. 0	6. 5	3. 7	188. 5	27. 9	725. 4
Average	80. 4	198. 2	116. 8	33. 5	16. 6	19. 3	11. 3	174. 7	187. 3	841. 5
Average output of held line per man hour from start of work to completion of control line (chains):										
1936	0. 09	0. 15	0. 14	0. 12	0. 23	0. 60	0. 04	1. 24	0. 06	0. 30
1937	. 11	. 22	. 03	. 11	. 71	. 31	. 67	2. 97	. 46	. 62
1938	. 13	. 07	. 04	. 29	. 06	. 10	. 28	1. 57	. 69	. 38
Unweighted average	. 11	. 15	. 07	. 17	. 33	. 34	. 33	1. 93	. 40	. 43
Average elapsed time from start to discovery (minutes):										
1936	146	22	12	[1] 2,816	990	30	125	33	690	540
1937	[1] 2,807	[1] 1,733	[1] 2,831	[1] 1,522	[1] 1,040	[1] 1,063	675	44	423	[1] 1, 349
1938	22	74	160	5	175	1	5	75	18	59
Unweighted average	992	610	1, 001	1, 448	768	365	268	51	377	649
Average travel time (minutes):										
1936	57	39	50	32	72	15	63	30	73	38
1937	166	170	76	40	360	280	100	38	167	155
1938	28	399	205	10	153	15	15	24	46	99
Unweighted average	84	203	110	27	195	103	59	31	95	97

[1] Lightning fires.

TABLE 3.—*Area burned in relation to travel time to larger fires*

	R-1	R-5	R-6	R-2	R-3	R-4	R-7	R-8	R-9	Total
Area burned by fires where travel time was 15 minutes or less (acres):										
1936	25,777	16,275	1,482	8,056	668	1,600	0	13,606	22,149	89,613
Percent above is of total [1]	55.6	20.8	16.6	50.1	12.4	38.7	0	13.7	13.5	20.5
1937	351	3,790	946	1,181	0	0	0	1,913	0	8,181
Percent above is of total [1]	10.1	23.0	17.0	40.5	0	0	0	5.2	0	8.0
1938	395	16,539	3,597	664	0	900	473	3,362	301	26,231
Percent above is of total [1]	15.2	25.1	5.5	51.8	0	47.7	12.6	7.2	0.6	12.0
Area burned by fires where travel time was more than 15 minutes but not more than 1 hour (acres):										
1936	10,667	32,541	0	2,189	0	0	1,424	11,191	32,861	90,873
Percent above is of total [1]	23.0	41.6	0	13.6	0	0	10.0	11.3	20.4	20.8
1937	0	6,019	1,260	0	0	0	0	9,651	6,020	22,950
Percent above is of total [1]	0	36.6	22.7	0	0	0	0	26.3	23.5	22.4
1938	924	18,244	6,573	0	2,318	0	0	12,473	1,573	42,105
Percent above is of total [1]	35.6	27.7	10.1	0	38.2	0	0	26.7	6.1	19.1
Area burned by fires where travel time was more than 1 hour (acres):										
1936	5,480	20,026	2,022	4,982	1,915	0	1,249	1,819	16,685	54,178
Percent above is of total [1]	11.8	25.6	22.7	31.0	35.5	0	8.8	1.8	10.2	12.4
1937	1,123	2,678	2,342	1,254	410	4,048	785	1,822	2,158	16,620
Percent above is of total [1]	32.3	16.3	42.1	43.0	21.0	66.6	20.5	5.0	8.4	16.2
1938	0	26,096	50,225	0	1,492	0	0	0	412	78,225
Percent above is of total [1]	0	39.6	77.3	0	24.6	0	0	0	1.6	35.7

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[1] Total referred to is total area burned for the year by fires of all sizes.

TABLE 4.—*Area burned in relation to distance from a road to point of origin of larger fires*

	R-1	R-5	R-6	R-2	R-3	R-4	R-7	R-8	R-9	Total
Area burned by fires where point of origin was ½ mile or less from nearest road (acres):										
1936	31,779	65,029	3,504	13,798	668	1,600	866	26,099	58,992	202,335
Percent above is of total [1]	68.5	83.1	39.3	85.9	12.4	38.7	6.1	26.3	36.0	46.4
1937	351	6,899	1,416	1,181	0	0	785	13,386	6,730	30,748
Percent above is of total [1]	10.1	32.0	25.5	40.5	0	0	24.3	36.8	26.3	30.0
1938	1,319	32,402	10,170	664	502	900	473	15,835	2,286	64,551
Percent above is of total [1]	50.8	49.1	15.6	51.8	8.3	47.7	12.6	33.9	8.9	29.5
Area burned by fires where point of origin was ½ to 1 mile from nearest road (acres):										
1936	0	3,813	0	1,429	0	0	0	0	723	5,965
Percent above is of total [1]	0	4.9	0	8.9	0	0	0	0	4	1.4
1937	0	454	0	0	0	0	0	0	0	454
Percent above is of total [1]	0	2.8	0	0	0	0	0	0	0	4
1938	0	0	0	0	0	0	0	0	0	0
Percent above is of total [1]	0	0	0	0	0	0	0	0	0	0
Area burned by fires where point of origin was 1 to 3 miles from nearest road (acres):										
1936	565	0	0	0	1,915	0	1,807	517	2,011	6,815
Percent above is of total [1]	1.2	0	0	0	35.5	0	12.7	.5	1.2	1.6
1937	803	1,927	2,142	1,254	0	3,028	0	0	1,448	10,602
Percent above is of total [1]	23.1	11.7	38.5	43.0	0	49.8	0	0	5.6	10.3
1938	0	20,922	3,855	0	0	0	0	0	0	24,777
Percent above is of total [1]	0	31.7	5.9	0	0	0	0	0	0	11.3
Area burned by fires where point of origin was over 3 miles from nearest road (acres):										
1936	9,580	0	0	0	0	0	0	0	9,969	19,549
Percent above is of total [1]	2.1	0	0	0	0	0	0	0	6.1	4.5
1937	320	3,207	990	0	410	1,020	0	0	0	5,947
Percent above is of total [1]	9.2	19.5	17.8	0	21.0	16.8	0	0	0	5.8
1938	0	7,555	46,370	0	3,308	0	0	0	0	57,233
Percent above is of total [1]	0	11.5	71.3	0	54.5	0	0	0	0	26.1

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[1] Total referred to is total area burned for the year by fires of all sizes.

Lessons Learned

Such an infinite variety of problems are involved in the management of large fire jobs that thoughtful men seldom fail to learn from each one something which should be guarded against in the future, something which should be done differently, some cherished belief which must be modified or abandoned. For 35 years I have been working on or observing suppression jobs, but I still learn something from every fire I reach.

Sometimes, alas, we "learn the same lesson over and over"—or do we? For example, I have learned throughout many years that there is some flaw in our management of larger fires which keeps us from getting a reasonable output of held line from a crew of a given size. Plenty of other people have learned the same thing. But, untrained as we are in the science and art of management, we have not found ways to act satisfactorily on what we have learned. Our learning has too often failed to lead to productive action.

The first essential in such matters is to grasp the need for change, the nature and importance of a problem, the chance to introduce something better. With that fact in mind, the outline for 1938 reports on larger fires requested a record of lessons learned by the man or men who had most to do with each fire. Some of the most suggestive answers received are quoted in this article. Quotations from the remainder will be continued in the next issue of Fire Control Notes. All fire-control men may benefit by the lessons learned on these fires. Perhaps these notes will help reduce the number of times lessons have to be "relearned" by different men—or by the same men. Because of lack of space, the statements of problems and lessons learned are clipped short, thus inviting the reader to do his own thinking. Publication of the conclusions does not necessarily mean that I agree.

Northern Region

Absaroka—Chico fire—429 acres.—The fire got over the line because of incomplete mop-up and men being gathered in a bunch to get water. (That lesson must have been learned a thousand times.—Ed.) The foreman in charge was a young, inexperienced administrative guard who, in his zeal to be helpful, left his crew to help on another part of the line. Had he had more experience, he would have recognized that his crew lacked training and knowledge of fire fighting, and he would not have left them. This might also be traced to the fact that the sector was too long for efficient handling by the sector boss. The country was so steep that the man in charge could not cover his whole line often enough.

More education and follow-up will have to be taken to overcome the fire risk in this locality. (Fire started by hot ashes thrown in cheat grass.—Ed.)

Furnish Forest Service overhead for crews obtained from other organizations. Locally and through the regional office get a line-up of the ability and training of fire crews outside of the Service which may be called to fight fires.

Assign more sector bosses where the topography requires it.

The regional office should continue training overhead and the forest should ask for plenty even at the risk of overmanning.

Kaniksu—Goose Creek fire—544 acres.—An organization principle was violated in that authority on the ground was divided between two heads and coordination was not effected. Two men, either qualified to handle the entire fire, were on the job. Each assumed the other to be in charge. Each aggressively worked on opposite sides of the fire, expecting the other fellow to see that balance was maintained.

Too much confidence was placed upon the ability of human beings to function on their own under emergency conditions. Much training has been given our camp bosses. They know the fundamentals of camp management, but we must not assume that they will, without actual (and much) experience, perform efficiently without fairly close supervision. Merely instructing a "trained" man to "go ahead" is not enough. I have not that much confidence in people. Further, it is not fair to the subordinate.

More attention should have been given to securing lunches for two crews. Slow delivery of supplies from warehouses was partly responsible for the delay.

Kitchen arrangements at base camp were inadequate. Four hundred men were served the first breakfast from one mess line, and there should have been at least 3 lines, which would have eliminated the confusion and delay.

More and better scouting should have been done. Scouts were inexperienced and did not arrive soon enough causing a loss of an hour or two by misplacement of two crews. On the morning of September 5 more men were sent to one sector than were actually needed, making it necessary to move them to another sector later.

The men planning the attack were confronted by a fire burning very fast and throwing spot fires ahead. Fire was in a heavy, dry, white-pine slash area which had been logged during the summer and was pushed by a 20-mile wind. It was figured that the fire would travel in a northeasterly direction, which it did to a certain extent, but not as fast as was anticipated. Consequently, more men were figured for the northeast side than actually needed. If our foresight had been as good as our backsight, more men would have been placed on the west side where there were barely enough men.

From 50 to 75 C. C. C. enrollees were used for clearing and holding down the hot spots until the trenching machine came along. Although these men did more hand trenching than necessary, the machine trenched it over again, and had no trouble in keeping up with the clearing crew. In fact, I do not believe it operated over one-half of the time, because the crew could not keep ahead. Mr. Sutliff was in charge of the machine. He and a mechanic changed off operating it, and three C. C. C. enrollees assisted in pulling. About 2½ miles of trench were built in 10 hours. Roughly, I would say that it did the work of 50 men.

Kootenai—Rocky Creek fire—380 acres.—The old story that an undetected spot fire blew up and caused this to be an extra-period fire holds true here.

In an analysis of the action on this fire by the supervisor, administrative assistant, two rangers, and an alternate and dispatcher who ere on this fire, it was agreed that the 25 men who were searching r spot fires were sufficient under the conditions that existed at the me of this fire. However, a spot fire got away, and caused the cond run; therefore, the number of men or the organization of them ust have been at fault.

Bulldozers were used to construct approximately three-quarters of mile of line on this fire. The main criticism was on account of some the burning fuel having been covered with duff and dirt which lded hours to the time required to do the mop-up job.

The time of arrival, the rate of spread, and the size and value of e rapid-spread area determined the action to take. I believe a illdozer line under not too difficult topographic conditions can be nstructed in less time than any other machine we have on hand. he cost of mop-up is, of course, a problem, but corral is the first b. Because of the value of bulldozers, and the possibility of break-owns, I recommend an extra machine on a fire-line construction job.

California Region

Angeles—San Antonio fire—3,270 acres.—We were slow in complet-g lines on some sectors, because of using crews too large—20 men er experienced crew leader. We should have (for this particular e, and it is true in most fall fires that spread with erratic lines and any spots) used *small* crews, 5 men to each trained fire fighter, and ade sectors small enough to provide closer supervision and more fective performance.

We learned that tank trucks should be of sturdier construction and mpletely standardized in design and operation, permitting change in erators and parts.

Should use paid tank-truck operators who are real mechanics and t rely on C. C. C. or temporary men. We had too many break-owns and were short of trained operators.

New Pacific Y pumps were very effective. Could use lighter pump three-fourth-inch hose effectively.

Tractors did a real job on this fire, particularly the RD No. 8. hese should work in teams with a hoist on one, and they can be put most anywhere. The RD No. 8 is far superior to any lighter models ed. We would have used these more effectively if equipped with ist.

Contour trails built by California Experiment Station on 1,000-foot tervals (for distributing rain gages) proved to be of great value in aking accessible in a safe manner many long fingers in slopovers. e feel that contour trails on 500-foot intervals will become an impor-nt part of the Angeles protection plan on extremely steep slopes and heavy cover. They need be only foot trails cleared 18 feet wide, it kept well cleared, and must not be blind trails, but have outlets th ways for safety.

Splendid cooperation by the United States Weather Bureau in eir special fire-weather forecasts during the entire fire season, and ecifically during the progress of this fire, made possible a more curate planning program for fire personnel needs and strategy to employed (particularly on backfire work).

Records show and this fire confirms: Our late fall fires are a problem we have not met in southern California. In the absence of early rains, in September and October we get Santa Anna conditions, extremely low humidity and high wind velocities up to 50 miles per hour. These conditions sometimes last a few days—sometimes 3 weeks. Practically all serious fires in southern California for the last 10 years have started under these conditions, indicating we have pointed our efforts to the normal season conditions and gained much ground, but now we must point to these abnormal fall conditions and plan to meet them by:

1. Study more intensively, the behavior of these late fall fires.
2. Provide 24-hour patrol and lookout service. This was a night fire—as have been two or three others.
3. Make more intensive use of closures regardless of private property interests.
4. Shorten elapsed time between discovery and first action by movement of equipment and men so as to concentrate in high hazard areas and high occurrence zones.
5. Intensify use of secondary lookout points.
6. Have night suppression crew on duty, dressed and ready to go.

In summary: Put *additional heat* on every control effort we normally practice for regular summer season.

Klamath—Slide Creek fire—4,117 acres.—Points of special significance on this fire were: First, the long travel time (12 to 17 hours) of crews going into this fire, with resulting high fatigue before going on to the line; and, second, the high resistance to control on the extremely dense vegetation characteristic of the Blue Creek drainage. Also, there is a decided lack of detection in this drainage. Night control can be obtained only by additional detection, more transportation facilities (roads) and crew attack.

Klamath—Red Mountain fire—500 acres.—This fire started within one-half mile of a point approved as a lookout station, which has not been constructed or manned to date because of lack of transportation facilities and funds.

Klamath—Potato Patch fire—550 acres.—It started on unprotected land outside the forest and a deliberate sacrifice was made to utilize natural barriers to corral that portion inside the forest boundary. In other words, the logical fire-control boundary does not coincide with the actual forest boundary.

Klamath—Red Cap fire—16,196 acres.—The suppression action on this fire was characterized by insufficient manpower and overhead in the first five burning periods, then a sudden build-up of men in a belated attempt to conform to the Forester's policy of immediate control. This sudden build-up led to placing more men in the field than could be adequately serviced—with consequent loss of efficiency. For example, on divisions 1 and 2, zone B, it took 400 men (including camp workers, etc.) 4 days to build and backfire 404 chains of line. Theoretically, 400 men should have built the line in 1 day, which would have been in accordance with the Forester's policy; but actually, they lost 50 percent efficiency because of lack of food and bedding; and it is estimated that about half of the remaining effort was dissipated in too wide line construction, so 100 men fully serviced and adequately supervised could have accomplished the same job in the same time.

The lack of sufficient men in the earlier stages of this fire resulted from three main causes: First, lack of speedy mobilization of available local laborers, because the machinery for mobilization was rusty through lack of use during 5 years of complete control by use of C. C. C.; second, failure to send in outside help; and third, scattered effort of available labor over 20 other fires that were starting or burning in the district at the same time.

To summarize, it is apparent that extreme effort should be made to satisfy the requirements of the Forester's policy as to control in the early burning stages. If the job continues to increase, there should be a reasonable adjustment of manpower needs to the point where they can all be adequately serviced and supervised.

Considerable difficulty was experienced at first through not having chutes prepared in advance. Considerable time was lost in trying to build chutes to exact specifications, until the urgency of the time situation led to simplification of the method of tying that was quite satisfactory. About a 10-percent loss was experienced through breakage and loss of chutes. On the basis of this experience, and a little experimenting this loss should be considerably reduced. The most interesting thing is that food could be delivered by airplane as cheap as by pack train. Use of special cargo planes with greater payload capacity should further reduce the cost.

Radio was used throughout the campaign—both ultra-high frequency and medium frequency sets. The ultra-high frequency was the most successful because of less interference and because of capable operation of the ultra-high frequency contact station at Orleans Mountain lookout. This station successfully handled 427 ultra-high frequency messages for five different fires in 14 days. The successful use of ultra-high frequency was also aided by a special stand-by unit used in connection with the T-set on Orleans Mountain which operated a buzzer when a set in the field turned on to the Orleans lookout frequency channel. This eliminated the necessity of maintaining schedules. The failures of the medium-frequency set were caused mainly by congestion of the one or two usable channels and by the lack of trained operators.

Radio has certainly come of age as a tool in fire suppression. Future application can be aided by making the present types of sets more efficient and simple, and through the unceasing efforts to keep a supply of well-trained operators available.

The Weather Bureau fire-weather field station forecasts were used throughout the fire. The assurance of this station that certain favorable conditions would continue made it possible to plan and construct a line into the head of the Red Cap Canyon, thereby saving about 4,000 acres that had appeared to be doomed.

The marvelous "do or die, stick to the bitter end" spirit of the short-term force was magnificent. It was with a feeling of deepest regret that with the first big rain storm on October 1 I was forced to dismiss them with the expressed hope that they could find enough to do through the winter to come back mentally and physically fit to tackle another season.

Los Padres—Messenger Canyon fire—520 acres.—Additional prevention contacts might have prevented this fire. It seems that the biggest problem confronting us today is to educate the public so that it becomes a habit to be forever cautious of the dangers that exist if they are using lighted materials, whether a match to light a cigarette or the cigarette itself. The older we get the harder it is to break a bad habit and form a new one. Suggest therefore, that our efforts would be better spent on the younger generation. This suggests to us the need for more prevention effort in our schools. Too much of our time is spent with the adults when attention to the younger generation would pay more dividends in the long run.

Because of the shortage of organized manpower we need more mobile tractor-trailbuilder units to do the line-construction work. It is felt that we have not gone strong enough in this type of use to supplement the shortage of manpower on fires. The transportation problem and lack of competent operators seem to be our main obstacles at the present time.

There was just criticism of the acting dispatcher for not sending the Piedra Blanca crew first. As it turned out the Los Preietos crews were sent first and later the Piedra Blanca crew was sent and arrived on the fire ahead of the Los Preietos crew. There has been a tendency on the part of the field force to hold back the suppression foreman and crew to protect the immediate vicinity should another fire occur. Therefore, to clear up any question about this, the suppression crews and foreman are to be the first crews sent to a fire regardless of district lines. As these are our best trained men, there is more possibility of holding a fire to a small size. The dispatcher's judgment is final.

It was felt that the paper work involved to complete the forms necessary was not started soon enough with the men available. Later on, during the fire, too many high-powered men were employed on this work trying to bring them up to date. It was also felt that the accumulative report was too complicated and three men were appointed as a committee to study the possibility of a modification.

While advantage was taken of an old cabin at the fire camp, it was brought out that the location of the timekeeper in this cabin proved a disadvantage. Hereafter, he should be located out in the open as called for in the plan, where he can see the crews leaving and entering camp.

Eight 5-gallon pack cans were dropped over the fire by plane, with the following results: Four of the cans were so damaged that all the water was lost. It was felt that this was caused by the type of chute used—6- by 6-foot burlap squares. The water cans were packed in barley sacks filled with hay. It took two men 2 hours to get this equipment ready to drop.

San Bernardino—Arrowhead Fire—12,362 acres.—The Arrowhead Fire originally started in a cabin on the crest of the San Bernardino Mountain range. After very thorough investigation as to the cause of the fire, it is believed that it was due to faulty flue construction. The defect was believed to have been where the thimble fastened to the brick chimney.

Extreme fire weather conditions existed at the beginning of this fire and continued throughout. A high wind was blowing at gale force, 45 to 50 miles per hour, and the humidity was very low, about 7%.

The cabin in which the fire started had wooden, untreated shingles, also others that burned near this one. Due to the high winds the burning shingles were probably the greater cause of the many spot fires.

A prevention lesson may well be discussed now. It is very strongly believed that strict building restrictions should be enforced on private land which may be accomplished through State or county legislation. This problem may also be worked on through more frequent contacts of property owners by forest officers.

The rate of spread of this fire was extremely great during the first few hours. Approximately 8,000 acres burned during the first 7 hours or over 1,000 acres per hour.

Because of the high rate of spread it is doubtful that any means of preparedness in presuppression would have reduced the size of this particular fire. However, it was thought that we were deficient in the number of tank trucks available at the beginning of the fire and during the fire. A tank truck at Arrowhead ranger station would be very desirable and had there been one there it would have arrived on the fire about 7 minutes after the fire was reported instead of 36 minutes as was the case. Even though there had been a tank truck at Arrowhead ranger station, it is doubtful that it would have made any difference in this fire. But as a presuppression lesson we can see the importance of having favorable distribution of tank trucks.

All line constructed and lost was uncompleted line. All backfire work that was done was held although it slopped over in places. Orchard torches were used. No acreage was burned through backfiring which would not have been lost by the fire anyway.

Sequoia—Fish Hatchery Fire—500 acres.—Investigation shows that regardless of any suppression action taken after the crews arrived on the fire, it could not have been controlled while still small. This fire was simply moving too fast after it got up a headway. It is barely possible that had we been able to put about 50 men on this fire at the time the first crews arrived, the fire could have been held to a small acreage. However, there was no failure in first attack action, as the first crew traveling 10 miles, arrived 17 minutes after the origin of the fire. We feel, therefore, that the only way this fire could have been prevented from becoming large would have been for the district ranger to have taken such action earlier in the season as would have prevented the fire from starting. This might have been possible had he specifically designated a dumping ground for the use of the Kern County Juvenile Camp and had this ground thoroughly fire-proofed at the start of the season.

The fire was in very rough country where night work was difficult. District Ranger Stathem now believes that it would have been better business to have reduced his night crews in size, concentrating most of his manpower on the line during daylight hours.

The lower fire line was built paralleling an oiled road and in some places within 800 feet of this road. The reason for this was that it was believed at the time that it was necessary to do this to protect a high-voltage transmission line that was between the fire line and the road. Looking back on this, it is easily seen, however, that there was an opportunity to drop back to the road and hold the fire and also protect the transmission line with a much smaller crew, inasmuch as the line would have been easier to hold on the road.

Shasta—Salt Creek fire—1,690 acres.—The more important lesson that I learned from this fire was that it burned more rapidly at night, especially downhill, than I had thought possible, and as a consequence, the fire made an advance beyond the point where it was estimated it would be held.

I believe the establishment and actual marking of stations along the fire line which corresponded to such stations shown on the fire maps were of great practical value in laying out and assigning divisions and sectors, preventing crews from getting lost, placement of radios, dispatching specialists, overhead and packers to specific parts of the fire line.

I did not learn from this particular fire, but rather had it impressed upon me again that one of our weaknesses of prevention is inadequate patrol, and the difficulty of getting a fire bug in the penitentiary.

Shasta—Wildcat Fire—550 acres.—I have a suggestion that may or may not be worth much. It is simply that a few words of prevention be used in connection with the large cigarette programs heard on the radio. To begin with, a large percentage of our man-caused fires are smokers' fires, also millions of people listen to the good cigarette programs. My idea is to have the radio announcer when he is telling how easy they are on the throat, etc., to say these few words in conclusion—"Before throwing them away, be sure they are out." If this idea is of any value, someone in the Washington office might interview the sponsors of these big programs and see what can be done in this method of prevention work.

Another suggestion for some cheap prevention work where millions of people would see it every day, is to show a colored slide in all movie theaters between features. A slide could be flashed on the screen screen saying "Be sure your cigarette is out before you throw it away. Thank you, U. S. Forest Service."

Shasta—Big Lake Fire—745 acres.—The most important thing I learned on this fire was that in slash type cover one should never try to attack the lead of a fire if it reaches an area of more than 3 acres. One should attack the rear first and pinch it in on both sides, putting the heaviest attack on the side toward which the wind is blowing.

Shasta—Another Big Lake Fire—425 acres.—One RD tractor used on this fire built line faster than 150 men could backfire and patrol.

The advantage of plenty of high-class overhead was one of the most important factors on speed of control on this fire. On every large fire we should get plenty of overhead as soon as possible.

One of the outstanding features on this fire was the placing of saddle and pack stock on the line immediately after the fire started. I believe that saddle and pack stock should be taken to all large fires as soon as possible to save overhead from a large amount of walking and to pack water and supplies to fire fighters.

Shasta—Mount Hedron Fire—8,300 acres.—This fire originated in a grass sage-juniper fuel type in gently rolling country at a time when the wind was blowing approximately 20 miles per hour. The fire was attacked by 20 men and 2 tank trucks within 11 minutes of its origin, and at that time it was about 3 acres in size and spreading rapidly. Cooperators were immediately called upon for help, but by the time they arrived the fire was completely out of control and was heading north before a strong gale wind.

The action of the fire indicated that it probably would have been a 300-acre fire even though there had been a full camp of CCC enrollees at Leaf which was only 8 miles away. It seemed to be one of those fires that had to make its run.

The fire (a smoker fire) would undoubtedly have been prevented had the hazardous bronco grass been removed from the highway right-of-way. This is a costly thing to do and we have not been able to secure satisfactory cooperation from the State Highway Commission to enable us to remove this annual hazard.

A Tractor-Trailbuilder Sit Down.—A trailbuilder was sent to this fire (name withheld) at shortly before noon of July 19, 1938, in the third period. It sat on the truck it came on and was not used until after I arrived on the fire and put it to work building line after the fire had been lost early in the afternoon of July 19. We could not have stopped this fire then without the aid of a trailbuilder. The last line we built was in an area of heavy winter storm damage full of down timber, reproduction, and broken tops. The fire was growing and coming too fast for this line to have been built by hand in time to backfire.—(Name of writer withheld).

Airplanes and Fog on the Green Mountain 1,500-Acre Fire on the Olympic National Forest.—An attempt was made to establish airplane camps in the back country on this fire, but because of fog which filled in during the second night this was impossible. To me this is significant. Airplane use on this forest will always be uncertain because of the rapidity with which fog banks form around the mountains and because of the extremely rough topography which forces planes to fly at a height that makes accurate work very difficult.—Vondis E. Miller, assistant supervisor, Olympic National Forest.

Cooperation or Incendiarism (name of forest and writer withheld).—Local cooperators were on this fire before Forest Service men arrived. This may be a healthful condition—or it may be a very bad situation. The area was, years ago, a very bad incendiary region. Numerous men in this area were then used on various fires all season. We still have to determine whether we are beginning to experience a recurrence of that incendiary situation. If so, we should obtain the confidence of some of the locals or place a law-enforcement man in the area to reside and have him determine what we are up against. If no incendiarism exists, then the cooperators should be praised highly for their work.

RECORDING PUMPER DATA ON A TOPOGRAPHIC MAP

J. Carlisle Crouch

Chief Ranger, Crater Lake National Park, U. S. National Park Service

Too often the story is: "We eventually found water and put pumps to work. If this could have been done sooner, the first and second breaks would not have occurred." The location of water supplies as a part of advance planning and the predetermination of the efficiency of pumping equipment as described by Mr. Crouch will help to get the pumps going sooner.

Reconnaissance and scouting of the area in which a going fire is located, as well as memory and field observations made in the past have been relied upon to determine if, when, and where water may be used by means of portable, high-speed motor pumpers. Such methods of determination obviously have many disadvantages and have necessarily resulted in some lost motion and effort in fire suppression, insofar as the use of water is concerned.

To combine the use of water with other fire protection facilities and to provide a simple reference to predetermine its actual and potential use on fires, we here at Crater Lake National Park have devised and prepared a pumper-data map to be used in conjunction with other fire-protection data maps.

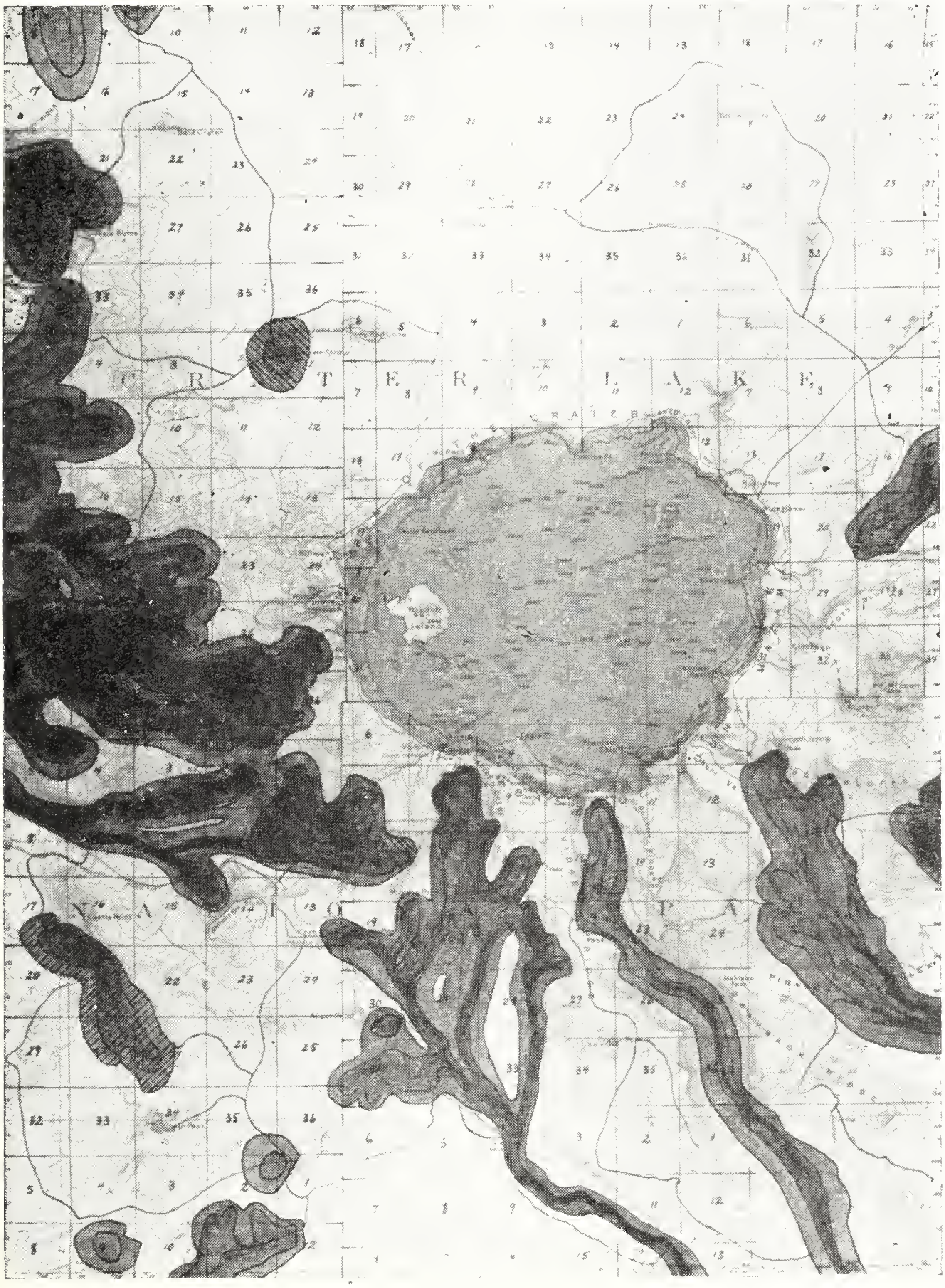
Extensive field studies were made to discover, to locate accurately, and to record sources of water suitable and sufficient for pumper use. These field data were recorded on a topographic map of the park area. Then the pumping efficiency of the equipment, based on the mean elevation of the park above sea level, was considered and tested, and this mathematical information was added to the map, so that not only was the location of the water supplies shown, but also the area which could be covered by the pumper.

The coverage of a pumper set up for action at the source of the water was determined conservatively as a horizontal distance of 1,500 feet and a vertical distance, outlet hose and with a minimum of suction, of 300 feet. The horizontal distance for the second pumper was determined as 1,500 feet, but with a vertical distance of 250 feet.

All of these data were applied to the map by means of different colors, one color to distinguish the area covered by one pump and another color to indicate the area covered by the second pump.

The map was designed for and used primarily by the dispatcher in his follow-up activities. Used in connection with the other fire-protection maps, it indicates readily and with reasonable accuracy whether or not one or more pumpers may be used, the timber types, and the ease and efficiency with which the equipment may be employed. In spite of the fact that a considerable area of the park might be reached by motor pumpers, this equipment is not substituted for fire fighters; but rather works with them, not for them.

The preparation of the map was not only interesting, but most elpful in formulating fire-protection plans. It will, no doubt, prove valuable complement of the fire-protection data now available.



opographic map showing pumper data. The inner darker area is located within reach of one pumper, the outer darker area can be reached with two pumpers operating in tandem. The cross-hatched areas are located within reach of water supplies which are not dependable for pump operations throughout the fire season.

LESSONS FROM LARGER FIRES ON THE SISKIYOU

L. L. Colvill

Assistant Forest Supervisor, Siskiyou National Forest, Region 6, U. S. Forest Service

A 3-day electrical storm in July 1938 started more than 60 fires on the Siskiyou—an all-time high for this forest for concentration of lightning fires in time. The spring had been exceptionally dry; winds were ruinous; the country was rough; and there was a serious lack of roads. Before the resulting "war" was over the 5 fires of more than 300 acres in size had burned over 48,000 acres—22 percent of the total area lost on all the national forests. The author was in charge of the largest of these 5 fires—the Chetco or Cedar Camp fire. Inspectors, who usually find many things wrong, could find no serious fault with his management of the job. But the fact remains that it took 26 days to corral the fire, which finally grew to more than 34,000 acres. Such fires afford priceless opportunities to learn the art of fire-suppression management.

Several important lessons were learned on the five large fires which occurred on the Siskiyou National Forest in the 1938 season:

1. *Regional office fire plan.*—These fires gave us a new conception of what constitutes "the worst probable situation," and the fire-suppression plan will require expansion to take care of another such occurrence, with particular reference to listing increased numbers of:

(a) *Pack and saddle horses.*—I believe it would be desirable for the regional office fire plan to include a list of pack stock available within the region, since it is not possible to obtain locally the number required for a situation such as developed on the Siskiyou last season.

(b) *Airplane facilities for transport purposes.*—Considerable delay was experienced in obtaining airplanes suitable for dropping supplies, and this indicates the need for more careful planning for and listing of this type of transportation.

(c) *S O S units.*—There is an apparent need for more S O S and scouting units. It would probably be best to utilize the regional office personnel for these units, since they are most likely to be available when needed. Also, in order to have men experienced in at least the key positions, suggest utilizing present S O S personnel in key positions and complete with "pick-ups" selected at time of fire from best available source. Experience for key positions is essential.

2. *We need to give more attention to the physical fitness of our fire-line overhead* when selecting and listing men in our fire plans for fire-fighting work. This is particularly true of C. C. C. foremen in charge of C. C. C. crews. Many examples could be cited on the Chetco and Siskiyou Fork fires where disability of overhead, such as weak heart, recent operations, or previous injuries of permanent nature seriously handicapped the organization of suppression crews. But probably more important is the irreparable damage to one's health which may result from the strenuous conditions required by this type of work. It is realized that the requirements of the C. C. C. camp work projects and restrictions limiting selection of C. C. C. foremen often result in a compromise detrimental to fire suppression.

3. *Leadership.*—Whenever choice permits, selection of foremen for fire-fighting work, especially C. C. C. foremen, should be based on their ability to provide inspired leadership, loyal to the management. Again, examples could be cited on the Lone Tree, Chetco, and Siskiyou

ork fires of C. C. C. boys striking and walking off the job, principally ecause of poor leadership.

4. *Burning out.*—There is need for emphasis on technique of urning out fire line as work progresses, so as to eliminate the necessity or excessive clearing and width of trench.

5. *Feeding men.*—Provisioning fire fighters on the Chetco fire was ot satisfactory, and suggested the need for one agency to handle all ationing. Provisioning fire fighters involves many problems charcteristic only of this type of work, such as providing rations best uited to transportation, especially by pack horse and airplane, and he preparation of large quantities of tasty, wholesome food, in many ases over open fires and under adverse sanitary conditions, which equires experienced cooks seldom obtainable from a C. C. C. kitchen. ogically, since the Forest Service is responsible for the control of the ire, it should have complete control of all contributing functions, of hich the provision of supplies is one of the most important.

6. *Civilian fire fighters for back country.*—Increased requirements nd restrictions, dual administration, and inexperience of Army fficers assigned to fire camps make employment of C. C. C. inefficient nd infeasible on fires in the back country requiring pack horse or irplane transportation, and a larger number of civilian fire fighters ust be depended upon to supply the necessary manpower.

7. *Camp management experience.*—Employment of large numbers of F men requires experienced fire-line-camp managers trained in all hases of the job. The functioning of Army officers in C. C. C. fire amps has reduced the opportunity for Forest Service employees to ain experience in handling food supplies and kitchen set-up, and our fficiency has been reduced accordingly.

8. *Aerial troubles.*—New problems arose in connection with airplane ransportation involving organization to meet the needs for large cale operations: Preparing chutes, packing loads, weighing and sting of contents, transportation of loads to landing fields, loading nd preparation of load lists, dropping and retrieving loads, tabulating amages, and assembling chutes for return to landing field.

Dense smoke and fog over the landing and dropping fields proved a erious handicap to airplane transportation, and indicated the need for esearch to find some dependable device for locating the landing and ropping fields when such conditions prevail. Suggestions advanced so ar include use of radio to provide communication between pilot and rew located at dropping field, operating a radio beam by use of a ortable storage battery located at the dropping field, and the casting of light beam from a semispherically shaped mirror located at the field.

9. *Need for "40-man crew."*—In rough and inaccessible areas, there an apparent need for trained crews of physically supermen capable f sustaining themselves on the fire line for periods of several days with minimum of S O S. Two methods offer possibilities for securing hese crews. They could be hired in advance of the fire season and mployed on construction work in the above-mentioned areas; or they ould be hired when the need arose, in which case it would be necessary o pay a much higher rate to obtain men meeting the requirements.

Dependable airplane service would materially increase the possiilities of maintaining a larger number of fire fighters on the line coninually, by making it possible to deliver cooked food and lunches to hem, thus eliminating the fatigue factor of hiking to and from camp.

RETRACTING STRINGS FOR FIRE DISPATCHERS' MAPS

PAUL M. WENTWORTH

Assistant Forester, Great Smoky Mountains National Park, U. S. National Park Service

Good fire control requires perfection in mechanical aids. No one will ever know how many failures are really due to lack of mechanical gadgets that would help the dispatcher to think and act with speed and precision when his bad times come. Here is one ingenious way of providing the needed equipment.

Practically every organization concerned with fire control finds it necessary to construct a map for fire location from cross bearings received from the lookouts. Where more than two or three towers are shown on one map it is desirable to have the strings which are used for the projection of the bearings retractable. Small tape reels that work very well are available for this, but in many instances the cost is too high.

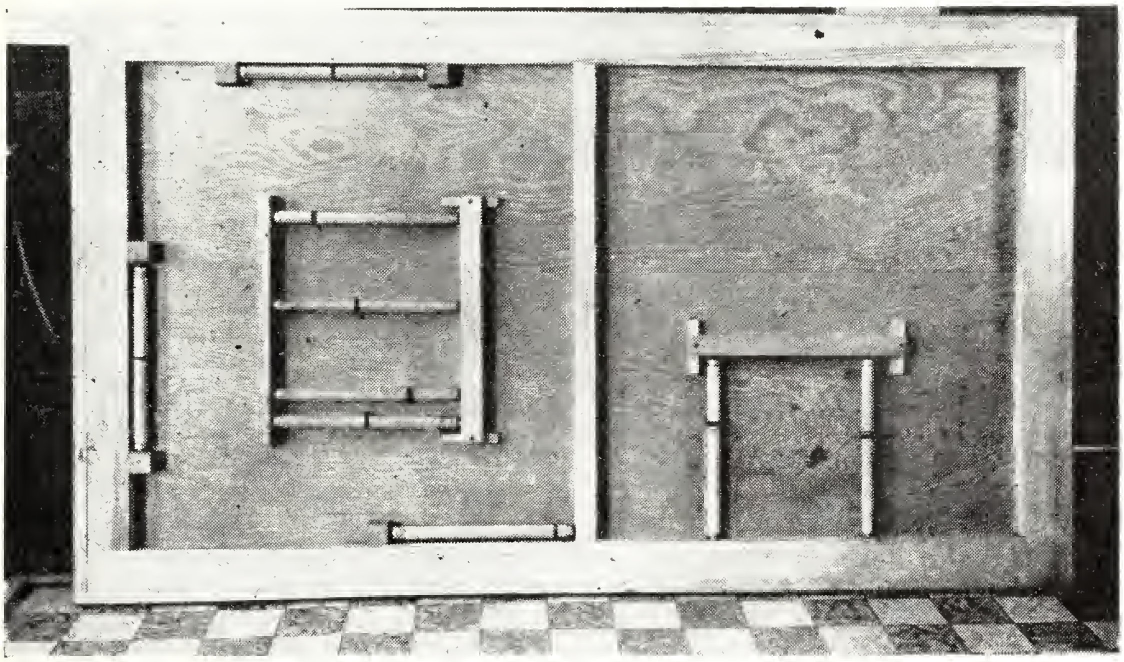
In the preparation of the dispatcher's map for the North Carolina side of the Great Smoky Mountains National Park in which nine towers were involved, the following scheme was used, which proved excellent in operation and reasonable in cost:

Short lengths of 3/16-inch diameter bronze rod were taken to a jeweler and drilled through the center with a 1/16-inch drill. The ends of this hole were carefully smoothed and rounded and the rod turned down to leave a very small flange on one end. Holes of the proper size were then drilled through the map board at the exact center of each azimuth circle and the bronze bushings pressed into place with the flange on the map side. Exact centering of the mounting hole is absolutely essential to maintain the accuracy of cross bearings and it was found necessary to use a drilling template to do this job correctly.

Good quality curtain rollers were purchased and cut as short as possible. This short length is desirable in order to eliminate as much as possible the bending of the rod when the string is pulled out. The small catches on the end were made inoperative and one roller was mounted on the back of the map board for each tower string. The rollers were located so that the proper side would be directly in line with the hole in the bronze bushing. In mounting the rollers, the regular inside type roller support was used for the end with the round pin, but the flattened end piece was inserted in a closely fitting slot in a wood block. The end of a piece of fishing line of the desired length was attached to the roller with a small tack and the remainder wound on the roller. The loose end was then pushed through the bushing and tied to a small brass ring. In attaching the rollers the support for one end was made removable to facilitate repairs or adjustments.

Using curtain rollers, the length of the strings is limited by the spring to about 6 feet. This should be sufficient in most cases, but where additional length is required it may be obtained by enlarging the size of the roller in one of several ways so as to increase the circumference where the string winds on it.

The dispatcher's map mentioned has been in use for several years
nd no trouble has as yet developed. Some noticeable wear has
ccurred where the strings pull through the bushings and it is sug-
ested that anyone using this scheme make the bushings of the hardest
aterial that can be drilled and turned down.



Back of dispatcher's map showing curtain rollers.

The question may arise in the minds of some as to the reason why
ngs are tied to the strings and not push pins as is the usual custom.
here is no doubt that the use of push pins on the strings has several
dvantages since the strings can be pulled out and the pins pushed in
hold them very rapidly, and it can be done with one hand. Our
ap is constructed with a soft pine pin strip around the edge and push
ins through the rings are used to hold the strings in position. In
ur case it was felt that rings would serve the purpose better for the
llowing reasons:

1. The strings can be pulled out and fastened as rapidly as the
eports could possibly be received.

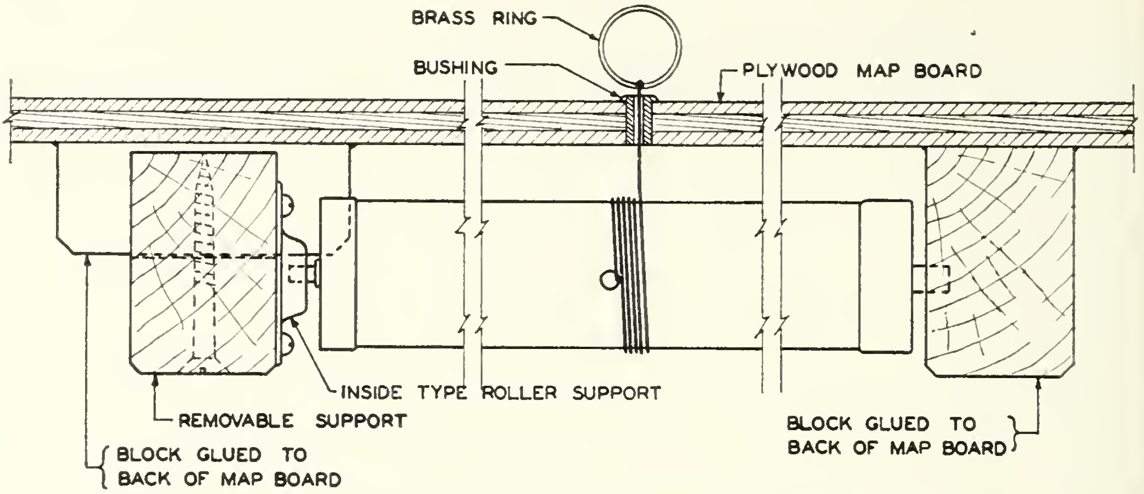
2. When the string for one tower is in use and reports on other
nokes are received from the same tower, the pins can be left in place,
e rings slipped off, and the string used for projecting the new bearing.
y using a separate pin for this new bearing the string can either be
ft there or returned to its original position very quickly. This
rocedure can go on indefinitely and it is not unusual during dry
eather in this area for one tower to report on as many as five smokes
ithin a very short period. It is seldom that more than one smoke at
time will directly threaten the park, and as soon as other smokes are
cated the string is returned to that smoke in which the park is most
terested.

3. With the pin slanted away from the lookout point the string
lways lies close to the map. With a push pin on the string it must be
ushed "home" before this occurs.

4. Last but not least, one very simple knot eliminates all possi-
ility of the string ever coming loose. Using pushpins the string must
rst be tied to the pin and then to the glass or metal top if one is to

be sure it will not slip off and possibly disappear behind the map board—a serious situation when things are hot.

For those who are particularly interested in costs, it is pointed out that the largest saving is in materials, and this method will be of most value to those organizations that have regular employees but little money for the purchase of materials. Where spare time or odd moments cannot be utilized for constructing the map the extra value of the time expended in mounting the rollers will partially offset the advantage of their small cost. Ten receding string reels can be installed in several hours, whereas the same number of rollers will require at least a day. Materials will cost about as follows:


BRASS RING
BUSHING
PLYWOOD MAP BOARD
INSIDE TYPE ROLLER SUPPORT
REMOVABLE SUPPORT
BLOCK GLUED TO BACK OF MAP BOARD
BLOCK GLUED TO BACK OF MAP BOARD

Detail of roller mounting for retracting strings.

Receding string reel (lots of 12 or more)	each	$1.50
Curtain rollers, good quality	do	.25
Turning of bronze bushings	do	.15
Fishing line, 6 feet		.03

Aerial Delivery of Supplies Being Used by State and Private Organizations.—On the Smith River fire, partly on the Siuslaw National Forest, the Western Lane County Fire Patrol Association and the State forestry department dropped something over 80 tons of supplies into their Marsh Creek base camp, two ships being in almost daily use from July 10 to July 28, 1938. Although the association and the State department obtained pack stock as fast as possible and immediately constructed necessary pack trails, they would have been unable to make even a good start in supplying necessary food had it not been for the use of airplanes. Our conclusion is, that not only is aerial delivery practical, but may even be essential in many cases where fires occur in inaccessible locations.—L. E. Garwood, fire assistant, Siuslaw National Forest.

What Spot Fires May Do.—The Rocky Creek fire on the Kaniksu National Forest was corralled at 10 a. m. of the first work period. While there was a sufficient number of Scouts looking for spot fires, and nearly 50 percent of the crew was working on spot fires, an undiscovered one about 400 feet from the main fire, got away even though 15 C. C. C.'s and a foreman were working on it 10 minutes after it was discovered.—Gordon T. Cornell, district ranger, Kaniksu National Forest.

WHAT IS "AVERAGE BAD?"

William G. Morris

Pacific Northwest Forest and Range Experiment Station, U. S. Forest Service

Preparedness means planning for whatever intensity of action may be required. But the dominant characteristic of fire danger is variability. Then how *can* intelligent planning be done? The author offers one answer to a very puzzling and important fire-control problem.

The term "average bad conditions" has been used with increasing frequency during the last 2 years to describe the fire-danger conditions for which we should lay most of our fire-control plans. The idea of making our principal plans for some level of conditions that is suggested by the term "average bad" seems to have been readily acceptable, but it has been difficult to define or describe just what an "average bad" condition is. How bad is "average bad?"

The term is satisfactory in discussions and in visualizing plans for such facilities as lookouts, firemen, etc., but when a planner actually attempts to determine the number of lookouts necessary under "average bad" visibility conditions, he must know what that means in terms of miles of visibility. Likewise, when he attempts to estimate the size of a suppression squad necessary to handle a fire at a given place under average bad wind velocity he must know what that means in terms of miles per hour. If the plans are to be revised currently, are to be checked, and are to be suitable for comparison with those of other administrative units, "average bad" conditions for which the planning is done must be established by the same yardstick.

It is suggested here that "average bad" be defined as the average of the worst half of the conditions that have occurred during a period of several years. To start with and until more records are accumulated, a 3-year period would serve the purpose.

This average of the worst 50 percent can be easily determined. Suppose we want to determine the average bad wind velocity, for example. Simply tally the wind velocity records in classes of miles per hour. Tabulate the cumulative total number of records or tallies by beginning with the lowest class and working toward the highest. From the cumulative totals pick the class above which lies one-half of the grand total number. Then compute the average of the velocities above this middle class. The accuracy of estimating the midpoint will be increased if narrower class limits are used for tallying the values near what is judged in advance to be the middle value. Very broad classes can, on the other hand, be used for tallying values near the extremes.

"Average bad" relative humidity, rainfall, or fuel moisture would be determined similarly from the average of the values below the midpoint instead of above it.

"Worst probable" is a term which has been used to signify the level of conditions with which emergency plans should be prepared to cope. "Worst probable" wind velocity might be defined as the point above which the highest 2 percent of the wind velocities have occurred in the past, and likewise "worst probable" relative humidity, fuel moisture, etc., might be defined as the point below which the lowest 2 percent of these values have occurred. This arbitrary 2 percent point is in keeping with L. H. Hornby's conclusion that about 2 percent of the fires occur under conditions which put them beyond human control during the first work period.

This point above which the worst 2 percent of the conditions occur can be determined from the same talley and array of values as those used in determining average bad wind velocity.

TANK-TRUCK STANDARDS

Fire Control Equipment Committee, U. S. Forest Service

During the meeting of the fire control equipment committee in Washington in February, a subcommittee composed of George W. Duncan, Fred W. Funke, William R. Paddock, and Ray C. Iverson discussed tank-truck standards and ways and means of developing them. This article is a brief of the conclusion reached, and will be of real interest to all users of this important item of equipment.

Standard sized trucks for fire suppression use should be the ¾-ton pick-up with four-speed transmission, and the standard 1½-ton stake body. Larger trucks for this purpose are not needed. Half-ton pick-ups should not be purchased for this purpose, but the ¾-ton trucks in some cases should be built up to the 1-ton class, and the 1½-ton trucks built up to the 2-ton class.

The tank valves and pump equipment on the trucks should be standard for the region in which they are used. The valves, pump, and power take-off should be the same size and make for the ¾-ton truck as those used on the 1½-ton truck. Then a region can carry a few spare parts which will fit all its tankers.

A unit of the type of the 6A Hercules pump and power take-off is recognized as the best transmission drive pump yet tried out for small capacity units, and it is therefore recommended that the regions use this type until some other pump is proved definitely better. For high lifts and large volume, however, the Byron-Jackson class of pump is needed, and the 3A Hercules and Panama fanbelt-driven type of pump is used where practically no lift is required, where there is low volume and pressure, and where short hoses are in use.

The subcommittee also recognized that there is need for auxiliary tanks that can be quickly loaded on any truck, the water from such tanks to be transferred to the regular power pumper or the truck equipped with such a pump as the portable type O Pacific Marine, and the water pumped directly on the fire from the auxiliary units.

It was the unanimous opinion of the group that permanent built-up pumper units should be used as much as possible. It was Mr. Funke's belief that the life of such units should be about 10 years, since the mileage traveled by such trucks is very low and most of the wear is in the motor which would no doubt have to be changed at least once in the life of the unit.

SHORT-TERM FOREST WORKERS

H. T. Gisborne

Northern Rocky Mountain Forest Experiment Station, U. S. Forest Service

When fire-research men take time out from their instruments and statistics to delve into questions of management, the "practical" men to whom management problems have been left may need to step lively to keep ahead. The author suggests some definite answers to the question: "What shall we do to make our practice more responsive to human and social needs?"

In the October 17, 1938, issue of the Service Bulletin, Roy Headley presented, "The plight of the short-term employee in the Forest Service." He stressed the unsocial policy of the Forest Service in giving its fire guards, particularly, not enough employment to permit them to live year in and year out, but just enough to tease some of them back another year and too much to permit them to get W. P. A. jobs the rest of the year.

In the October 1938 issue of Fire Control Notes, Maj. Jno. D. Guthrie flashes another red light in our faces. He stresses the indisputable fact that we are substituting C. C. C.'s for a lot of the good fire cooperators we used to have, and that if the C. C. C.'s should suddenly cease, we would find ourselves in one deep hole. The major also mentioned, all too briefly, the fact that our extended use of the C. C. C.'s to pad our first, second, and third lines of defense "was never intended in the beginning." He refrained from pointing out that this "never intended" use, for regular fire-control positions, deprives many of Headley's 5,000 or 6,000 short-term workers of much employment that we used to be able to give them.

These two dangerous practices of the last few years have combined to produce a third danger—the nonexistence of a supply of trained lookouts and "smokechasers" *adequate* for our known needs during critical fire seasons. The short-term employment now offered to temporary men ordinarily brings back only 60 percent of the trained men needed during years of *average* fire danger. The best 40 percent of those trained each year get jobs elsewhere the next year, if they can. That's a natural characteristic of "best" men. Then instead of using our double-up positions to give training and work to the many additional men that we know we will need in critical years, we do the doubling, some of it anyway, with C. C. C.'s.

Here in region 1 we have a "fire plan" for each forest which shows the number of positions to be manned and the number of men needed according to the degree of danger existing. The supervisors are definitely "for" these plans, with one outstanding and unanimous exception. They ask: "Where and how am I going to step out and get that last 100 to 150 men called for, if and when critical danger occurs, and get men with enough fire experience and training to be worth hiring?" They, the supervisors, will never be able to answer that question under our present policies and finances. The answer to that question is, however, the answer to our problem of adequate fire control in critical years.

We therefore seem to have (1) an unsocial policy toward our short-term workers, (2) too many fire-control eggs in the unpredictable C. C. C. basket, and (3) no provision whatever for an adequate supply of really *trained and competent* lookouts and "smokechasers" for use during critical fire seasons, which are the ones that wreck the good records hung up during all the other years. To a single-track fire researcher, unversed in social economics and interested primarily in assuring adequate fire control at reasonable cost, the last point is the major one. To what avail are all the fine points of silviculture, all the to do about stream flow and erosion control, all the hub-bub about campgrounds and recreational facilities, and all the brain busting over land-planning policies, unless we can first *guarantee* fire control adequate to the requirements of each of these phases of forest-land management?

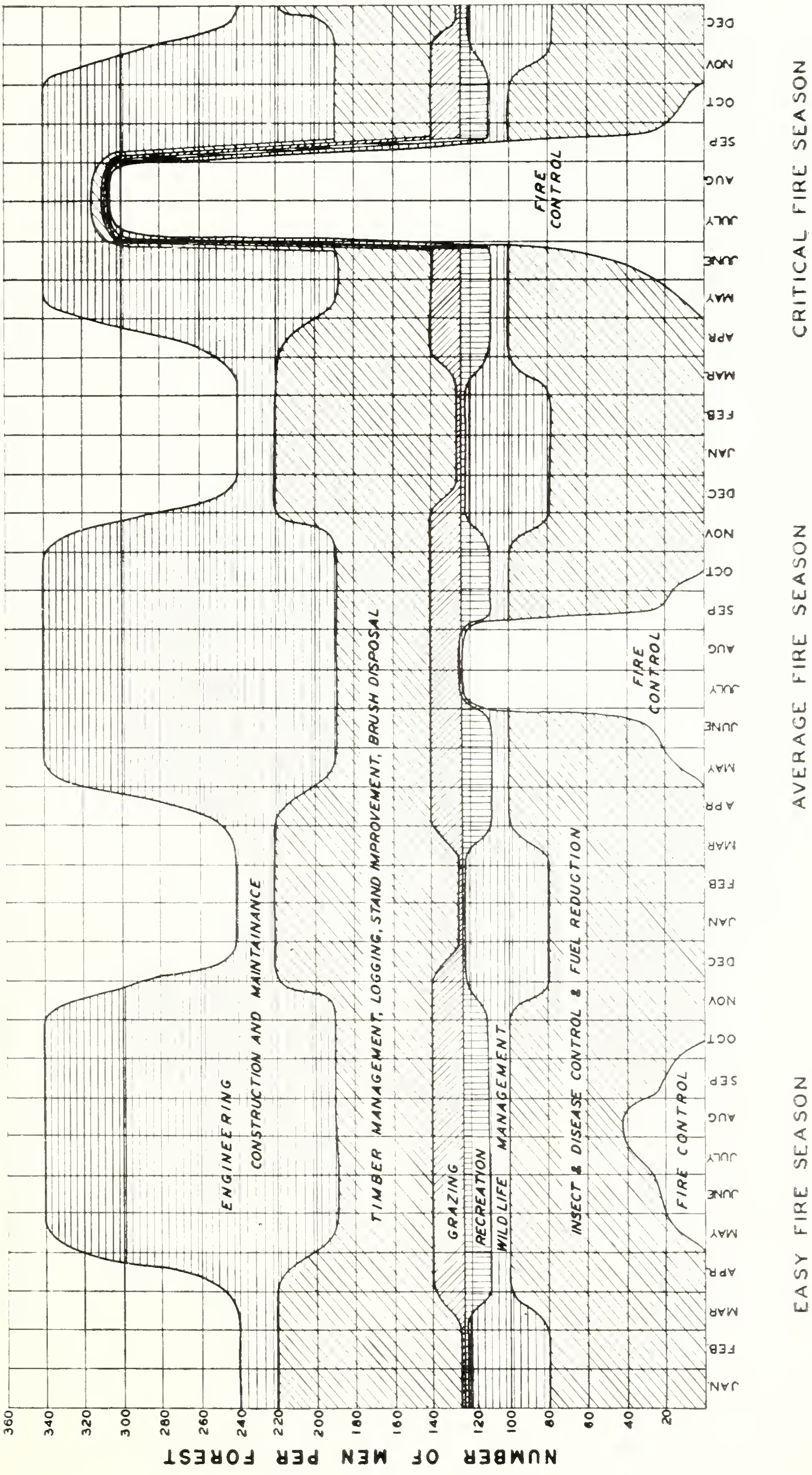
The situation may be different in other regions, but here in region 1 the guarantee of adequate fire control during critical seasons is still the quicksand on which we are erecting many of our other forestry totem poles.

It would seem that some kind of a plan ought to be evolved which would minimize all three of these basic weaknesses. Under a socially minded government someone should have the power and the funds to rectify a social indignity affecting 5,000 or 6,000 worthy citizens; if the C. C. C.'s were not intended and should not be used in fire control except in emergencies, then that policy should be enforced, especially if it will contribute to alleviation of the bad conditions; and if the crux of adequate fire control does now lie solely in the critical season, then that is the bull's-eye at which we ought to aim. The accompanying chart may serve to indicate one possible and partial cure for all three of these present weaknesses.

The chart is intended to illustrate merely the general policy of coordination of labor between divisions of the Forest Service so that (1) adequate fire control may be assured during critical seasons, (2) all divisions may assist—and benefit—in giving longer employment to the forest fringe population, and (3) C. C. C.'s will be used for fire control only during emergencies.

In constructing the chart, the known fire-control needs of a critical season on a typical north Idaho or western Montana forest determined the maximum number of men shown. That is the bull's-eye. This maximum of 340 men includes ranger district temporary overhead, lookouts, "smokechasers," warehouse men, packers, truck drivers, cooks, and crews (held available), but does not include fire fighters. Several thousand fire fighters may be needed occasionally, but that is where the C. C. C.'s come in—during emergencies only. Some 300 *trained* lookouts, "smokechasers," and shock troop crews are needed per million and a half acres, however, whenever danger rises to class 6 and bobs back and forth between 6 and 7, if we are to guarantee adequate fire control. You cannot get *competent* lookouts and smokechasers from the C. C. C.'s. The boys are too young and inexperienced in the woods. In fact, you cannot get them anywhere without providing *training*.

To have trained and competent lookouts, "smokechasers," and crews available whenever the unpredicatable critical season smites us, requires reemployment of local woodsmen and forestry-school students



Coordination of labor uses.

year after year. Can you imagine the Navy storing its battleships in dry docks between wars and then attempting to man them competently by enlistment or even draft after the enemy fleet has set sail for our shores? The Navy applies organization planning first, tactics and strategy second. We might apportion our emphasis similarly.

The other subdivisions or allotments of labor, aside from fire control, shown by the chart, are estimates and approximations at best. The seasonal give and take between divisions is the main idea proffered. It should work best, of course, if the Forest Service had a Division of Forest Protection, rather than merely a subdivision of fire control. Then all forms of insect, disease, and fire control could be coordinated, serviced, and staffed by a year-round operating organization. Every insect and disease-control man would be ready to step into his preassigned fire-control job whenever the danger rating warranted the shift. Every fire-control man would likewise have his out-of-fire-season job on insect and disease control. (No need for quibbling as to what agency will provide the "technical guidance." Merely the labor is at issue here.) Other divisions of the Forest Service, generally, would be tapped for help only during critical seasons, when each man would take his preassigned position as lookout, "smokechaser," or crew man, for which he had been *properly trained.* During average fire seasons the Division of Forest Protection might draw a few men from one or two other divisions, but during easy seasons it would be entirely self-sufficient. The present problem of time and funds for training would be solved automatically by adoption (and financing) of this major principle of coordination of labor.

The last major feature intended to be shown by the chart is the reduction of expense possible during the winter months by recognizing the fact that about one-third of our short-term workers either do not want to work through the winter or have to return to their stump ranches and homes for the duration of rigorous weather. This exodus usually starts, in this region, early in November and is completed a few days before Christmas. Along in April these "hole-up-for-the-winter" specimens begin to feel like working again. With a month's annual leave, however, probably the other two-thirds could and would stay with the job year round.

Staggering of annual leave throughout the winter would help to solve another problem in fire control by eliminating the present costly and sometimes dangerous method of granting leave during temporary lulls in the fire season.

One-Lick Method on the Cedar Camp or Chetco Fire.—One point learned was that the one-lick method of line construction can be used to advantage when only untrained civilian fire fighters are employed. Two occasions came up where we needed considerable line built in short order to stop the fire from burning an increasingly large area. On both occasions crews were organized from men totally unfamiliar with this method of line construction and the line was built in heavy brush at high speed. With more trained foremen and straw bosses, I believe it can become the most efficient method with any type of labor available.—M. M. Nelson, district ranger, Siskiyou National Forest.

HOSE-PIPE LINE FRICTION-LOSS CHART

L. W. Lembcke

Wisconsin Conservation Department

Since many thousands of feet of fire hose of various sizes and kinds re used in this country by State and Federal agencies, it is believed hat the men using this hose will find helpful a chart showing relative riction loss in different sizes and kinds of hose which will give a basis or calculating the quantity of water that can be conducted through a articular hose when pump characteristics are known.

Chart A shows the approximate characteristics of a pump that neets the requirements of United States Forest Service specification I. S. F.–273. Chart B shows the friction loss in various sizes and inds of hose and pipe. If in practice the hose is run up grade, 1 ound of pressure must be deducted for each 2.31 feet of vertical rise, n addition to the friction loss, to arrive at the total loss in pressure.

The chart is made up by plotting friction loss in pounds per 100 feet f hose against gallons per minute on log-log graph paper. The dvantage of the log-log graph paper is that the scales are so arranged hat the resulting graph is a straight line. Since it is known that the raph will be a straight line, fewer test points are necessary to plot he graph and corresponding readings will be more accurate.

The principal loss of head in hose or pipe lines is the result of the riction along the inner wall and among the liquid particles. The onditions which govern the amount of the friction are: (1) The iameter of the hose or pipe; (2) the nature of its inner surface; and 3) the velocity of the liquid. From the many experiments that ave been made in addition to our own and from the laws of hyraulics we know that the amount of frictional resistance offered s: (1) Independent of the pressure in the pipe or hose; (2) proporional to the extent of frictional surface; and (3) varies nearly as the quare of the velocity. The chart is used as follows:

Example 1.—Suppose it was necessary to lay 4,000 feet of hose to fire (40- to 100-foot lengths). The difference in elevation is 100 eet. Using 1½-inch linen hose with a pumper capable of pumping gainst a head of 225 pounds per square inch, how many gallons per ninute can be delivered at 25-pound nozzle pressure?

	Pounds
ozzle pressure	25
oss in head due to elevation	$\frac{100}{2.31}=43$
Total	68

225 pounds — 68 pounds = 157 pounds that may be used up in friction.

$\frac{157}{40}$ (100-foot lengths of hose)=3.9 pounds that may be lost in each 100 feet.

On the chart the 1½-inch linen hose graph line crosses the 3.9-ound friction-loss line at *21* gallons, which would be the amount f water that could be pumped through the hose with a pump capable f pumping 21 gallons per minute at a 225-pound head. A United tates Forest Service Specification M. S. F.–273 pump should operate atisfactorily under these conditions and pumps 20 gallons a minute.

Example 2.—If 1½-inch rubber-lined hose were used under the same conditions, the following quantity of water could be pumped:

	Pounds
Nozzle pressure	25
Loss in head due to elevation	$\frac{100}{2.31}=43$
Total	68
From the chart, at *30* gallons per minute we find a loss of 3.2 pounds per 100 feet. For 40 lengths of hose we have 40 by 3.2	[1] 128
Total loss	196

From the performance curve we can see that an M. S. F.–273 pump will pump 30 gallons at 210-pound total pressure.

Example 3.—If 2-inch rubber-lined hose were used with the same pump, we could expect the following results:

	Pounds
Nozzle pressure	25
Loss in head due to 100 foot-elevation	$\frac{100}{2.31}=43$
Total	68
At 47 gallons we find a friction loss of 2.5 per 100 feet or 2.5 by 40	100
Total loss of head	168

From the pump performance curve it can be seen that the pump will deliver about 47 gallons at 168-pound pressure.

Example 4.—Now take the problem as before but increase the length of our hose line from 4,000 to 6,000 feet, using the same pump.

	Pounds
Nozzle pressure	25
Loss in head due to elevation	$\frac{100}{2.31}=43$
Total	68

225−68=157 pounds that may be used up in friction.

$\frac{157}{60}$(100-foot lengths of hose)=2.6-pound pressure that may be lost in each 100-foot length of hose.

On the chart the 1½-inch linen hose graph line crosses the 2.6-pound friction-loss line at 16.7 gallons, the amount of water that could be pumped through the hose with a pump capable of 16.7 gallons at 225-pound pressure. Referring to the pump-performance curve, it will be noted that the pump will not operate under those conditions.

Example 5.—Suppose we try 1½-inch rubber-lined hose under this condition. From the chart we find that the 1½-inch rubber-lined hose will conduct 25 gallons with 2.2-pound loss per 100 feet.

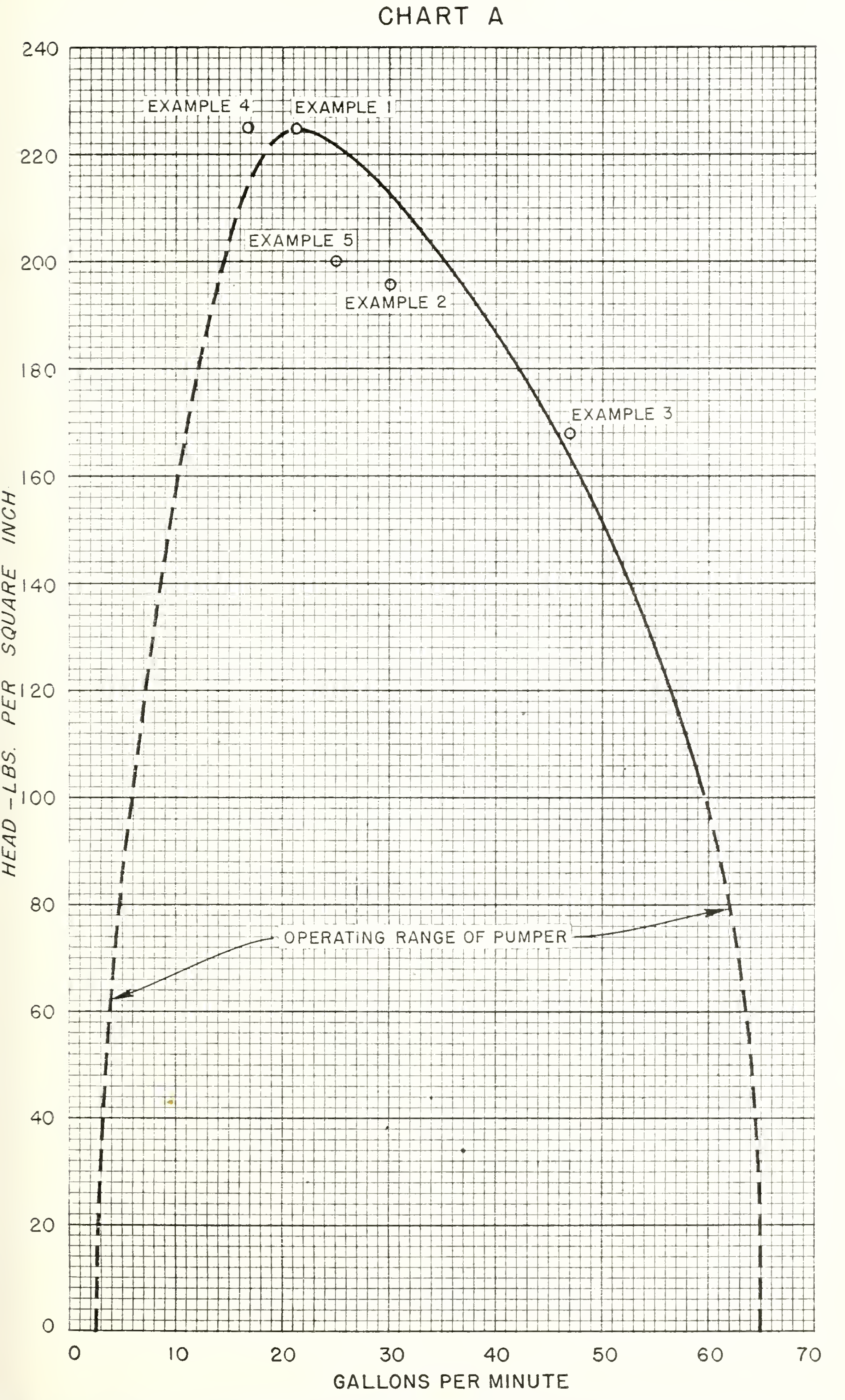
	Pounds
Nozzle pressure	25
Loss in head due to elevation	$\frac{100}{2.31}=43$
At 25 gallons the friction loss	68
2.2 by 60	132
Total loss	200

Referring to the pump-performance curve, we find that the pump will operate under these conditions.

From examples 4 and 5 it will be seen that under certain conditions a given pump can operate with rubber-lined hose while it cannot with linen hose of the same size, because of its larger friction factor.

---

[1] Loss.



hart A.—Approximate curve representing minimum performance of a pump meeting the requirements of United States Forest Service Specification MSF-273.

FRICTION LOSS IN HOSE AND PIPE

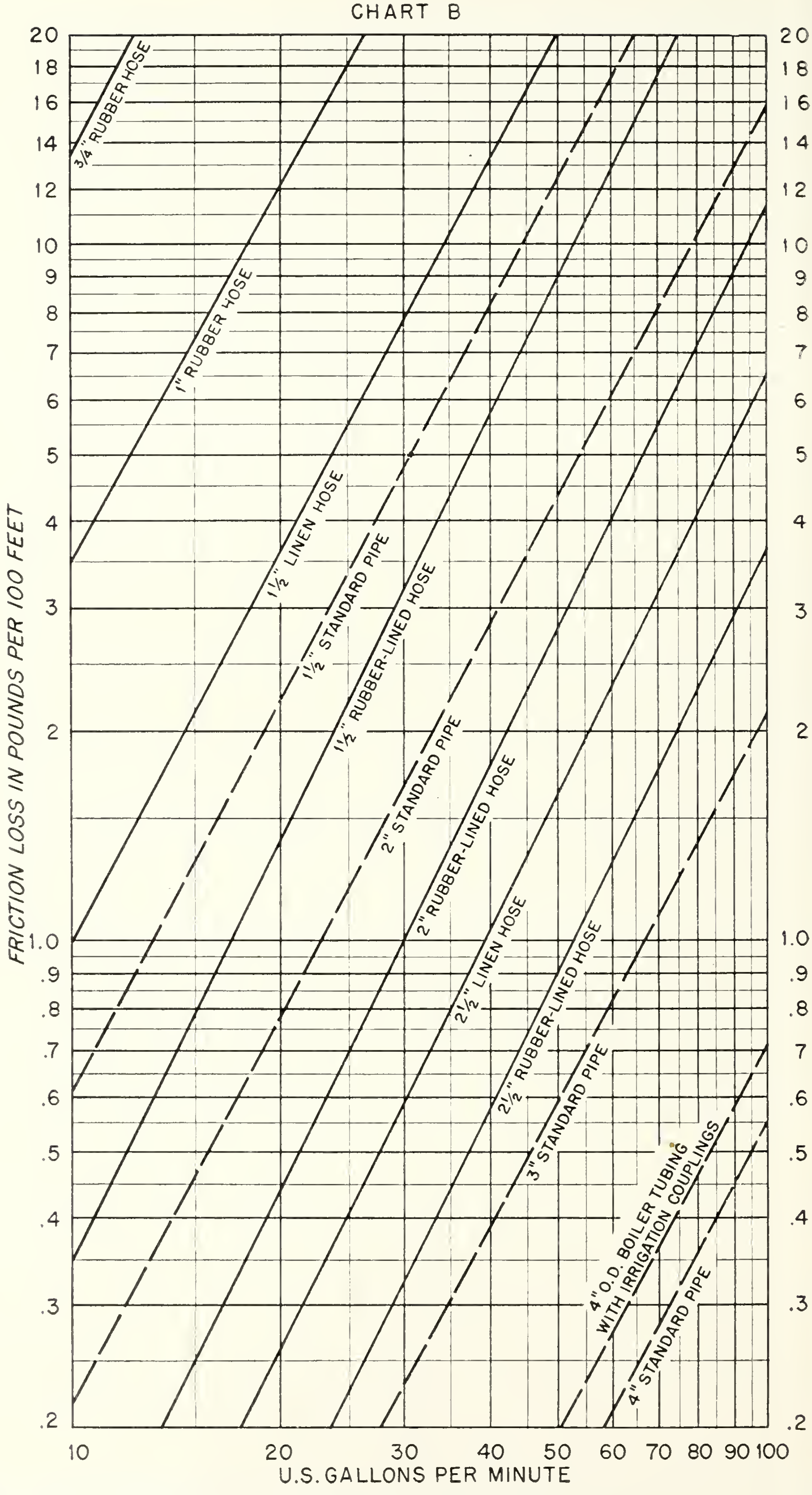


Chart B.—Shows friction loss in iron pipe; linen, and rubber-lined hose. Data from tests and other available information.

HARNEY PORTABLE FIELD LIGHTS

D. P. Kirkham

Harney National Forest, U. S. Forest Service

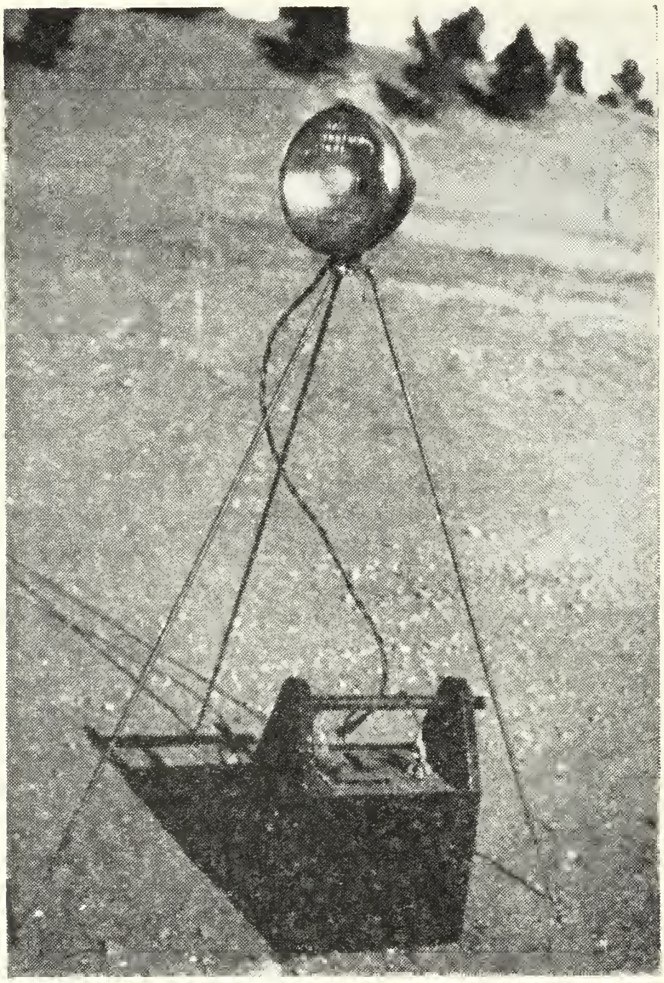
A need for adequate lighting facilities to reduce the accident hazard d permit greater efficiency in fighting fires at night, particularly herever a considerable part of the fire perimeter to be worked has ied down, has long been recognized. Lanterns are poorly adapted such use, and in many localities in Forest Service region 2, the rchase, maintenance, and servicing of a sufficient supply of indi- dual headlights is not feasible, particularly for the use of C. C. C. ews.

During the past year, Foreman Leo Harbach of C. C. C. Camp –23, Harney National Forest, has been experimenting with various pes of crew lights for night fire fighting. This has resulted in the velopment of a simple field light, which he believes will reduce the cident hazard of night fire fighting and greatly increase the effi- ency of night crews in the Black Hills territory. In addition, he s modified the idea to produce a camp light and a trouble light.

The field light is portable and consists of three pieces—a tripod, a adlight, and a battery, and is designed for use on line construction mop-up work. The headlight is an old Chevrolet truck headlight. his has been reworked and a standard drop-light socket soldered to e reflector to take the place of the regular light bulb. The socket equipped with a pull-chain switch, the chain extending through an ening near the bottom where it is readily accessible for switching e light on and off. A standard 6-volt, 25-watt light bulb is used. he headlight is attached to the tripod by using the regular bolt that ld it to the truck. The bolt goes through the top ring of the tripod d is fastened by means of wing nuts and so arranged that the light n be focused to either side. The light can be focused up or down moving the rear tripod leg. The legs of the tripod are 44 inches gh, made of ⅜-inch round iron with the ends pointed. The center the tripod is the top washer of an old bramble tent. This was cut wn, leaving six prongs extending outward for attaching the legs means of bolts and wing nuts. The voltage is supplied by a stand- d 6-volt, 13-plate storage battery. Number 8 twisted, insulated res are used for connecting the light to the battery with alligator ps and are easily attached and detached from the battery terminals.

This light can be easily moved. The tripod and light can be carried one hand and the battery in the other, since the battery is in a ywood case with the ends and bottom made of 1-inch lumber. A ndle extends the length of the battery and is 4½ inches above its rface. The battery and case weigh 40 pounds and the tripod and ht 9 pounds.

By actual test, a battery fully charged will run this light, equipped th a 6-volt, 25-watt bulb, 21 hours. This is sufficient for two nights the fire line during the short hours of darkness in the usual fire ason, although to insure maximum service, it is advisable to change tteries every night. This can be done easily, since we always have ucks with fully charged batteries on all fires.



Harney portable field light developed for night fire fighting by Leo Harbach.

For actual line construction this will give a wide beam of diffused light with no glare for a distance of 300 feet, which is usually sufficient for a crew of 20 to 25 men, with another manning the light. This man directs the light where it is most needed and carries it along as the fire line is constructed. Time saved, better line construction, and the reduction of hazards by having adequate light more than pays for the extra man to operate the light. The use of this light greatly reduces the hazards of falling over cliffs or stepping into mine shafts when directing night crews to the fire line.

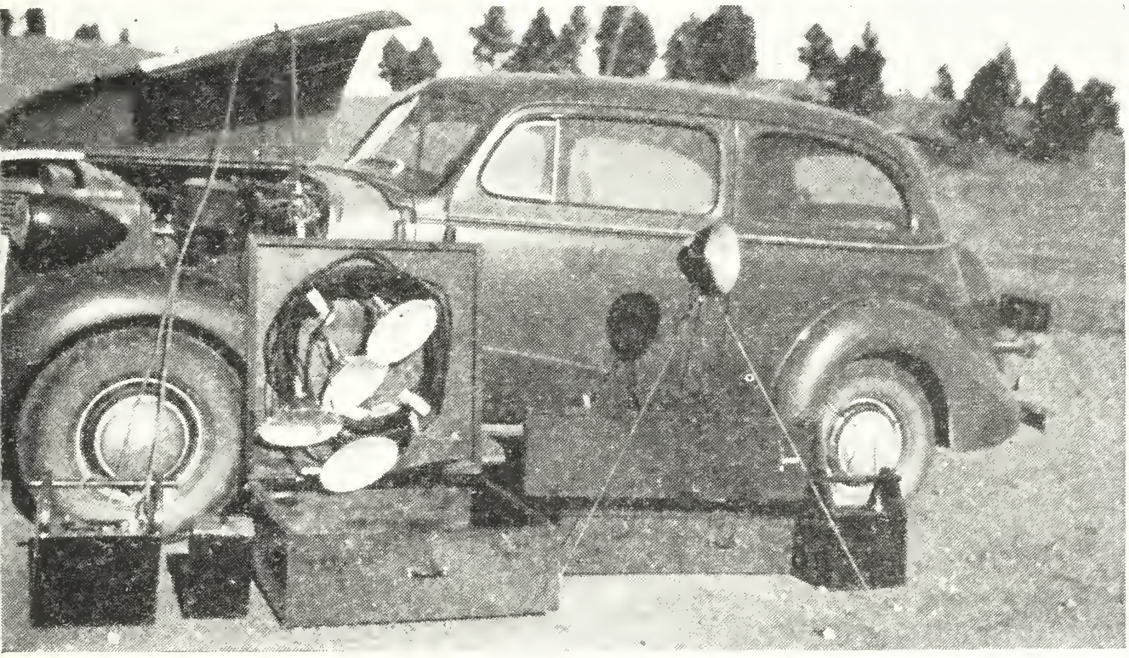
The light is also very efficient for mop-up work on the numerous small fires that occur on the Harney Forest. On a fire of 5 acres or smaller, which has largely gone black, it can be set up in the center and the light turned as the work progresses. Very satisfactory work can be done up to a distance of 500 to 600 feet from the light. In previous fires it was difficult to pick up small smokes unless there were flames or sparks. With this light, the tiniest smokes can be readily located and extinguished by the back-pack crew immediately, thereby having the fire completely "dead" by daylight.

For transportation in cars or trucks, the headlight and tripod are carried in a plywood case 12 by 8 by 46 inches, which is large enough for two complete outfits, plus extra bulbs. The battery case is just large enough to hold the battery. The sides extend about 3 inches below the top of the battery so it can be easily removed for recharging.

Adequate light for fire camps has long been a cherished dream of all camp bosses, cooks, and fire fighters. It has been a dire necessity but never a reality. It is believed that the camp light developed by Foreman Harbach meets the need. Although this light was designed primarily for use at fire camps, it is ideal for other night work, such as pouring concrete and for innumerable other jobs that must be done with a night crew.

The camp light consists of five sockets equipped with 6-volt, 25-watt bulbs, connected by means of two 100-foot No. 4 insulated copper wires. This heavy wire is used for minimum resistance. A smaller wire was tried but satisfactory results could not be obtained. Standard pull-chain light sockets are used, and are equipped with 10-inch light shades to keep the light on the ground. The lights are spaced 20 feet apart. In order to protect the bulbs two pieces of No. 9 wire are soldered at right angles on the bottom of the shade. No. 1

sulated copper wire is used for drop cords, and is satisfactory if not re than 6 to 8 inches in length. Any 6-volt battery can be used supply the current. Since pick-ups or trucks are always available our fire camps, a special battery is not needed. One end of the . 4 copper is equipped with alligator clips, and the current is tained by simply connecting one wire to the starter cable and the er to the frame of the car or truck or any bolt that will make a od ground. It does not make any difference which cable is attached



Harney field light, camp light, and trouble light developed by Leo Harbach.

the starter cable. The far ends of the 100-foot No. 4 cables are sulated, not connected together, and a 100-foot ⅜-inch sash-cord connected to this end for attaching to a tree or pole.

If a fire is in isolated territory and the fire camp set up away from ssable roads, the lights and battery can be packed in. A battery ly charged will last 9 hours with a string of five lights, and if the gine is running and the generator set to charge 10 amps, the battery ll remain fully charged.

For maximum light it is desirable to have the lights from 10 to 12 t above the ground. This can easily be done by stringing the wire trees or cutting suitable poles. The string of 5 lights will give equate light for any size fire camp up to about 150 men. If desir- le, 3 additional lights can be added which will make the string proximately 160 feet long. This can be installed in a semicircle er a fire camp and will give adequate light for both cooks and the w.

The camp light is housed for transportation in a plywood case by 30 by 30 inches in size. The outfit complete weighs 37 pounds. the light is to be packed, the case can be made smaller.

Foreman Harbach has also developed a "trouble light" which can used in case of accidents, for repairing tires, and making emergency pairs. This light consists of 12 feet of twisted insulated No. 14 h-cord. One end is equipped with a pull-chain lamp socket and a olt, 25-watt bulb, with a wire shield attached to the socket to tect the bulb At the other end of the cord the wires are equipped with alligator clips, one of which is clipped to the starter cable and the other to the frame of the car or truck. This usually gives sufficient light for any necessary night work or other emergency. If more light is needed, a 50-watt, 6-volt bulb can be used. In Government trucks which carry C. C. C. enrollees to fires or on other trips light is often needed. The trouble light comes in very handy when a truck arrives at a fire after dark and the fire cache has to be unloaded and tools issued to each enrollee. Without adequate light this is a difficult and dangerous task.

This light can be carried in a plywood case 6 by 6 by 8 inches which is large enough for an extra bulb, screwdriver, and a pair of pliers. The trouble light, complete with box, weighs 4½ pounds. A battery fully charged will run this light 21 hours.

Heartache and Apology Department.—Does Fire Control Notes have a "heartache column?" (It is hereby formally launched.—Ed.) If so, here are the outpourings of an anguished soul. If not, here they are anyhow.

The April 1939 issue carried a note and illustration of the fine region 1 elapsed time calculator. No complaint thus far—only commendation.

On June 29, 1936, I wrote you a letter submitting an elapsed time calculator which I developed in May 1932 while at the Northern Rocky Mountain Forest Experiment Station. Mr. Godwin replied on July 1, 1936, saying, "This seems quite appropriate for use in the first issue and we will hold it along with other material we are assembling for that purpose." No complaint thus far—only commendation for you, Godwin, the experiment station, and myself.

But—My calculator was never published. And now, the improved calculator, modified from mine (I hope), has been published. No commendation now, except for region 1's new calculator—from me, only complaint.

Is Alexander Graham Bell to be forgotten because he did not develop the French desk-dial phone? (Your readers will, I am sure, see the analogy!)—M. A. Huberman. Forest Service Division of Silvics, Washington.

While Mr. Huberman writes with gracious lightness, the editors offer a serious apology for the oversight. They have something of a "bug" for giving proper credit for original creative work.—Ed.

Due-Credit Department.—The Red Cross fire-prevention program appears to be gaining momentum very rapidly, and bids fair to become a Nation-wide plank in that organization's program. As it gains in importance and becomes better known, it is but natural that the more important forest officers engaging in it will gain credit for their work, and, of course, this is as it should be. However I hope you will remember that Lloyd Hougland on the Colville is the man who conceived the idea so far as Spokane is concerned, and who first contacted Wallis and sold him the idea. I think Lloyd should have a lot of credit, and so this note.—J. F. Campbell, Forest Service region 6.

olume 3 Number 4

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A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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HE USE OF CHEMICALS IN FOREST-FIRE CONTROL

T. R. Truax [1]

Senior Wood Technologist, Forest Products Laboratory

The Forest Service made its first test of chemicals for fire sup-
ession in 1911 when carbon tetrachloride, a popular material for
mmercial extinguishers, was found to have no superiority over
ter in forest fire suppression. The World War led many men to
lieve that "chemical bombs" could be used effectively on forest
es. In response to this belief, the Chemical Warfare Division of
Army conducted an inquiry. Nothing happened. But the de-
e to make use of chemistry in fire control persisted. The author
orts on the latest and most comprehensive attempt along this line.
a result of a 3-year research project, over 3½ tons of monoammo-
m phosphate with a 5 percent admixture of sodium dichromate to
vent corrosion of equipment, have been distributed to national
ests for the conclusive test—in the hands of fire crews on actual
s as they occur. The current cost of this chemical mixture—
cents per pound, plus about 2 cents for freight—may prevent its
ensive use except in aerial attack, if that venture should prove
cessful. Foam producing solutions are also in experimental use
national forests, but the special equipment required for their use
man-pack cans is not satisfactory.

Research studies were undertaken in 1936 by the United States
rest Service, with the objective of learning whether chemicals
ld be used to advantage in forest-fire control and suppression.
dies (*1*, *5*, *8*) [2] of limited extent had been made at various times in
past, but no continuous and comprehensive investigation had
r before been attempted in this country. The use of chemicals
xtinguishers for other classes of fires and under other conditions
stimulated the interest of both the public and those responsible
the protection of forest areas from fire in the possibilities of their
in forest-fire suppression. To the chemist, familiar with com-
tion and its control, the possibility of finding a material that is
standingly superior to water or to existing chemical extinguishers
not seemed particularly promising. To the fire fighter, who has
understanding of conditions surrounding forest fires, the use of
nicals as an agent in control and suppression has perhaps been
e of a hope than an expected development. However, the desire
mploy all available ways and means of combating forest fires
to discover, if possible, any new materials of value, led the Forest
vice to undertake a study of the possibility of making effective
of chemicals.

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knowledgment is made to the Division of Fire Control for financing this investigation; to the various
experiment stations and administrative units of the Forest Service and the Michigan Department of
rvation for cooperation and assistance in making the field tests; and to members of the Forest Products
atory, particularly George M. Hunt, Arthur VanKleeck, Howard D. Tyner, and Bruce G. Heebink,
articipated actively in the investigation.

mbers in parenthesis refer to list of references at the end of this report.

It was recognized at the beginning that forest fires present a situ tion not at all analagous to the type of fires and the conditions und which chemical extinguishers are now largely employed. The pri cipal characteristics of forest fires as related to the possible use chemicals are: (*a*) They occur in the open with an abundant supp of oxygen for combustion and frequently under substantial wind v locities or air drafts. (*b*) The fuels are almost entirely cellulos with a wide range in form, size, and arrangement. Heavy timbe grasses, leaves and needles, limbs and branches, rotten wood and pe are but a few of the types of materials involved. (*c*) A large p centage of forest fires occur in more or less inaccessible areas wh transportation is difficult, water is often scarce, and the only equ ment available during the early stages of attack are hand tools, su as shovels, axes, and back packs for water.

The purpose of this paper is to present the results of the inves gation begun at the Forest Products Laboratory in 1936 and co tinued through 1937 and 1938. The results pertain primarily to use of chemicals in water solutions, although the results of some te on chemical foams are included. The data are from laboratory vestigations and from field tests on fuels in several forest regions the country.

Method of Investigation

The investigation involved three steps: (*a*) Review of the lit ture and search for promising materials, (*b*) laboratory tests to co pare the effects of various compounds and to study variables in ex guishing fires in wood, and (*c*) field tests to compare results of more promising materials on natural fuels of different types arrangement.

The survey of the literature covered some 440 papers, patents, other references, and indicated that a large number of materials in form or another have been proposed or tried as extinguishing ag or retardants to combustion. Most of these may be classifie (*a*) gases, which alone or in mixtures with air of proper concen tions will not support combustion, for example, carbon diox (*b*) liquids, which may be a single component, such as carbon te chloride, or water solutions of one or more chemicals; (*c*) solids, as dry sodium bicarbonate; and (*d*) foams, most of which are a ture of water, chemicals, and carbon dioxide gas. Some mate may occur in two or more forms, for example, carbon dioxide w is available as gas, liquid, or solid.

The usefulness of gases as extinguishing agents is generally co ered to be limited to fires in inflammable liquids or to other burning terials in confined spaces where the fuel can be covered or surrou by the necessary concentration of gas to prohibit combustion. involves maintaining a layer of gas over the fuel until it has co below the combustion temperature. For materials burning in open and in deeply glowing fuels where a considerable accumul of heat exists, this condition is generally impractical to obtain. these reasons, gases, which are effective under special situation not appear to offer promise as forest-fire extinguishers.

Solids have been suggested primarily because of their smothering ects. This may result from a liberation of combustion-retarding ses or from the air-excluding action of inert materials combined th their mass cooling effect. The bicarbonates, some of which lib- ate carbon dioxide at fire temperatures, and dusts of heat-resistant mpounds illustrate this type of material. The action of finely vided soil (dust) is familiar to most forest-fire fighters.

The blanketing action of foams, which is of value on burning oils, generally regarded as of less significance on fuels of the type involved forest fires. While foam-type extinguishers are recognized as of lue for fires in wood, paper, textiles, and the like, they are not cessarily considered superior to water or solutions containing large rcentages of water (*6*, *10*). However, the increase in volume of ams over the original chemical solutions, as a result of entrapped rbon dioxide, seemed to offer large theoretical advantages and stimu- ed considerable interest in their possible use in forest-fire suppres- n.

Based on a consideration of the types of fuels involved, the condi- ns surrounding forest fires, the extinguishing action and limitations various chemical agents, and the equipment and problems involved use, it was decided to confine the investigation primarily to water utions of chemicals. Water is now used extensively, and it seemed ssible that chemical solutions might be used in the same equipment. me tests were included on foams in order to compare them with the re promising chemical solutions and water, although the use of ms would obviously entail special equipment.

The choice of chemicals for test in water solutions was based in ge part upon the work of previous investigators, but a few were luded because of theoretical or other considerations. Barrett (*1*), tchell (*5*), Stickel (*8*), and others in the Forest Service had gotten ne encouraging results with potassium carbonate and calcium oride a number of years ago. Thomas and Hochwalt (*9*) had re- rted marked effects for solutions of potassium and sodium salts in inguishing gasoline fires. Work at the Forest Products Laboratory d compared the fire retarding action of a large number of chemicals en impregnated into wood (*3*). Russian investigators (*7*), in 1932 d subsequent years, had investigated several chemicals to determine ir value in forest-fire control. From these various sources and ers the list of chemicals for test was prepared.

Laboratory Studies

Laboratory tests were used as a method of getting within a limited ne the comparative extinguishing properties of a considerable mber of chemicals in water solutions of different concentrations. re than 800 standardized and controlled small-scale, fire-extinction ts were made with different chemical compounds and concentra- ns of solutions. The usual procedure was to make extinction tests a standard wood fire with a 25 to 30 percent (by weight) water ution of a given chemical, and, if it showed appreciably higher ectiveness than water and was otherwise promising, additional tests lower concentrations were made.

The method of test was an adaptation of that used by Folke (2 a Danish investigator, in a study of the factors involved in fire e tinction. The standard fuel pile consisted of 18 pieces, 1 by 1 by inches in size, of clear, surfaced, southern pine wood. After co ditioning to 6 to 7 percent moisture content, the pieces were select by density to give a total weight of approximately 990 grams (2. pounds) for the 18 pieces. The pieces were arranged in the form of crib—3 in a layer and 6 layers high on a wire screen attached to t platform of a scale that permitted continuous reading of the weig during test. The wood was ignited by means of a battery of 4 g flames placed directly beneath the crib for 1 minute. The burni was allowed to progress until 50 percent of the original weight of t crib was lost, at which time extinguishing began. The liquid w applied as a small jet from a glass nozzle at a predetermined a controlled rate.

Data were recorded of the volume of liquid used for flame extincti and for total extinction (including glow), of elapsed time for flame a for total extinction, and of the crib residue remaining after comple extinction. A series of several tests was made with each chemic solution and concentration. Similar tests were made using water the extinguishing agent, to afford a basis for evaluating the effectiv ness of the chemical solutions.

The comparison of the various chemical solutions and water w made at a constant rate of application of solution and under qui air conditions. Tests were made later on the standard fire, usi different rates of application of extinguisher and under varyi horizontal wind velocities.

Results of Laboratory Tests

Of the data obtained, the volume of liquid required for extinguishi the fire was considered the most reliable and probably most significa indication of effectiveness. The time required for extinction parallel rather closely the volume used, but since the application was int mittent during the later stages of extinguishing (suppression of glo the elapsed time was considered less accurate than volume of liqu used. The amounts of fuel consumed during extinguishing, as det mined by the residual weights of cribs, also indicated comparati effectiveness and gave the same general conclusions as did the relati amounts of liquids used. The effectiveness of the chemical soluti was expressed, for convenience, as a "superiority factor," determin by dividing the volume of water (as a standard) by the volume chemical solution used. Values were determined separately for fla extinction and for total extinction, including both flame and glow.

The results obtained with various chemical solutions of about 25 30 percent concentration are shown in table 1. The effectivene expressed as superiority factors, ranged from less than one (less eff tive than water) to more than two (twice as effective as water). amples of chemical solutions that were less effective than water citric acid, tartaric acid, and ammonium nitrate. Examples of so tions showing two or more times the effectiveness of water for to extinction are phosphoric acid and the ammonium salts of phospho acid. For extinction of flame alone, the acetate, bicarbonate,

rbonate of potassium showed the highest effectiveness of the ma- rials tested. Monoammonium phosphate, which showed little su- riority over water for flame extinction in quiet air, showed high periority for both flame and total extinction in a later series of tests ade under substantial wind velocities.

BLE 1.—*Extinguishing properties of concentrated water solutions of chemicals compared with water*

[Tests made under quiet air conditions, liquid applied at rate of 26 cc. per minute]

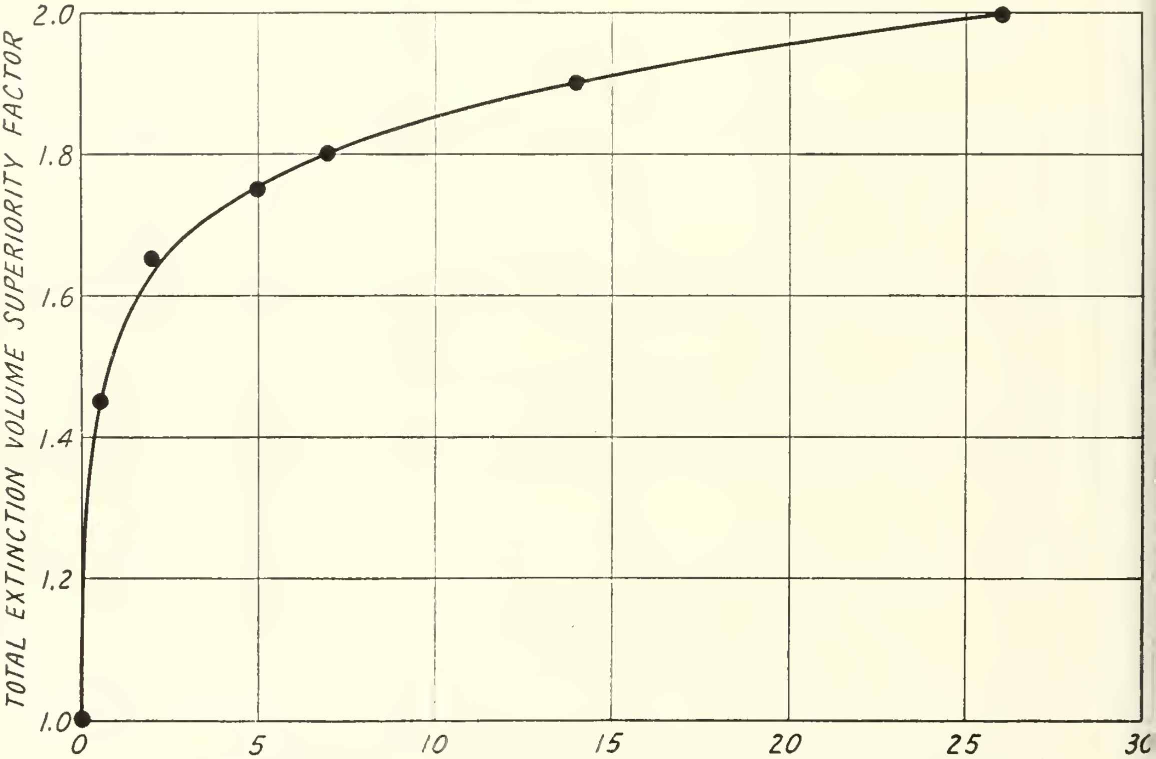
Chemical	Concentration of solution by weight	Superiority factor [1] based on volumes used for—	
		Flame extinction	Total extinction
	Percent		
d, citric	25	0.90	0.75
d, phosphoric	26	1.50	2.40
d, tartaric	25	.75	.60
minum sulphate	23	1.00	1.40
monium carbonate	28	1.10	1.40
monium chloride	28	.95	1.50
monium nitrate	25	.80	.80
monium nitrate	29	1.10	1.00
monium phosphate, di-	26	1.30	2.10
monium phosphate, mono-	26	1.20	2.00
monium sulphate	26	1.10	1.70
cium chloride	26	1.10	1.50
altous chloride	25	1.00	1.30
iium chloride	27	1.25	1.80
nesium chloride	25	1.20	1.70
nesium sulphate	30	1.10	1.30
assium acetate	30	1.75	1.80
assium bicarbonate	25	1.70	1.55
assium carbonate	25	1.90	1.70
assium chloride	25	.90	1.20
ium acetate	27	1.50	1.60
ium chloride	25	1.10	1.00
ium phosphate, mono-	24	1.00	1.50
ium silicate	22	1.00	1.20
nous chloride	25	1.10	1.50
chloride	30	1.30	1.70

Calculated by dividing the average volume of water by the average volume of chemical solution used xtinguishing similar fires.

Boric acid, hydrochloric acid, oxalic acid, ammonium borate, am- nium oxalate, and sodium sulphate were tested also, but only at ostantially lower concentrations of solutions. Of these, only boric d showed appreciable superiority over water. At 5 percent concen- tion, which was about the maximum obtainable with boric acid, effectiveness compared favorably with that of phosphoric acid or the mono- and dibasic ammonium phosphates at similar concen- tion. Tests were also made on combinations of two chemicals in same solution, but the results indicated no advantage over the gle chemicals at the same total concentration.

With a number of the more effective chemical compounds, tests re made on solutions of lower concentration to study the relation concentration to effectiveness. The tests were made under quiet conditions and at the same rate of application as used in the com- rative series on various chemicals. Figure 1 shows the results ained for monoammonium phosphate, plotted to show the relation ween concentration and total extinction effectiveness. It is evident t a large percentage of the superiority of the chemical solution over ter is obtained with 1 to 2 percent concentrations and that the increase in effectiveness is less rapid for concentrations above percent.

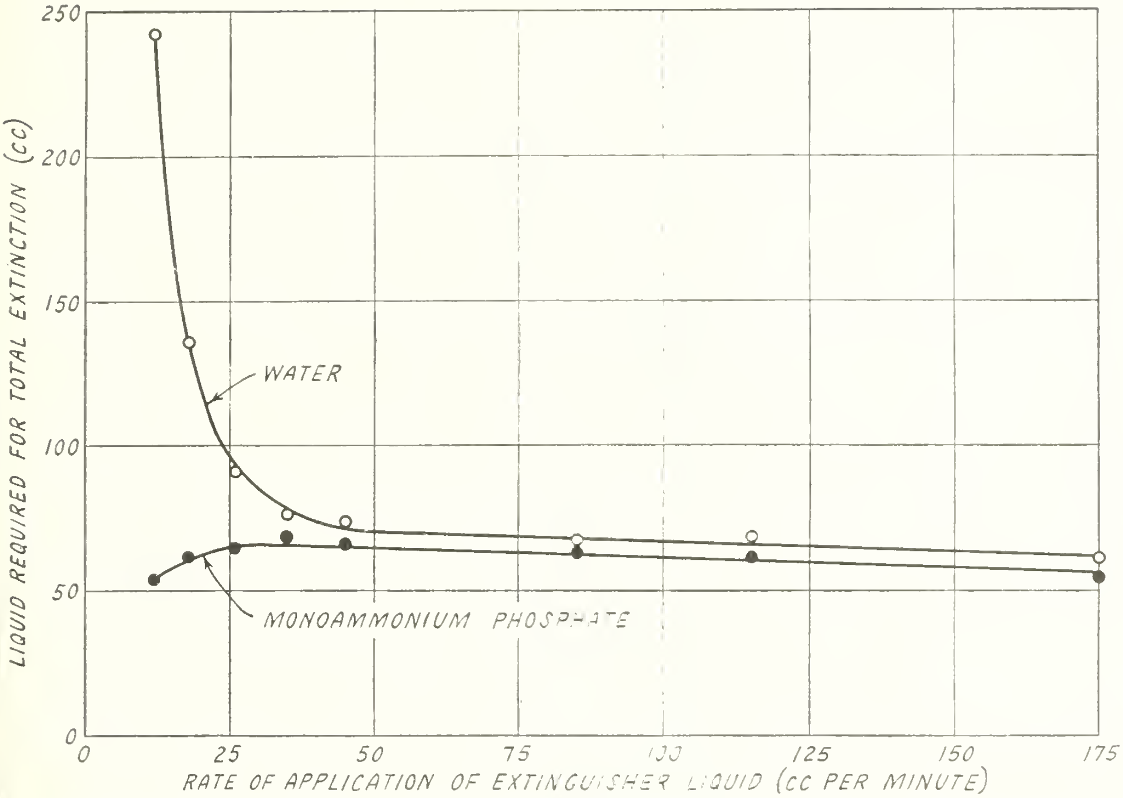
A third series of tests was made to study the effect of varied rat of application of extinguisher. A 10-percent solution of monoam monium phosphate was compared with water on standard fires unde quiet air conditions with rates of application of from 12 to 710 cc. p minute. The actual volumes of water and chemical solution require for total extinction, for rates of application within the range of 1 to 175 cc. per minute, are shown graphically in figure 2. The com parison of various chemical solutions shown in table 1 was made a rate of 26 cc. per minute. At a rate of application of about 40 c per minute and above, the advantage of the chemical solution ov



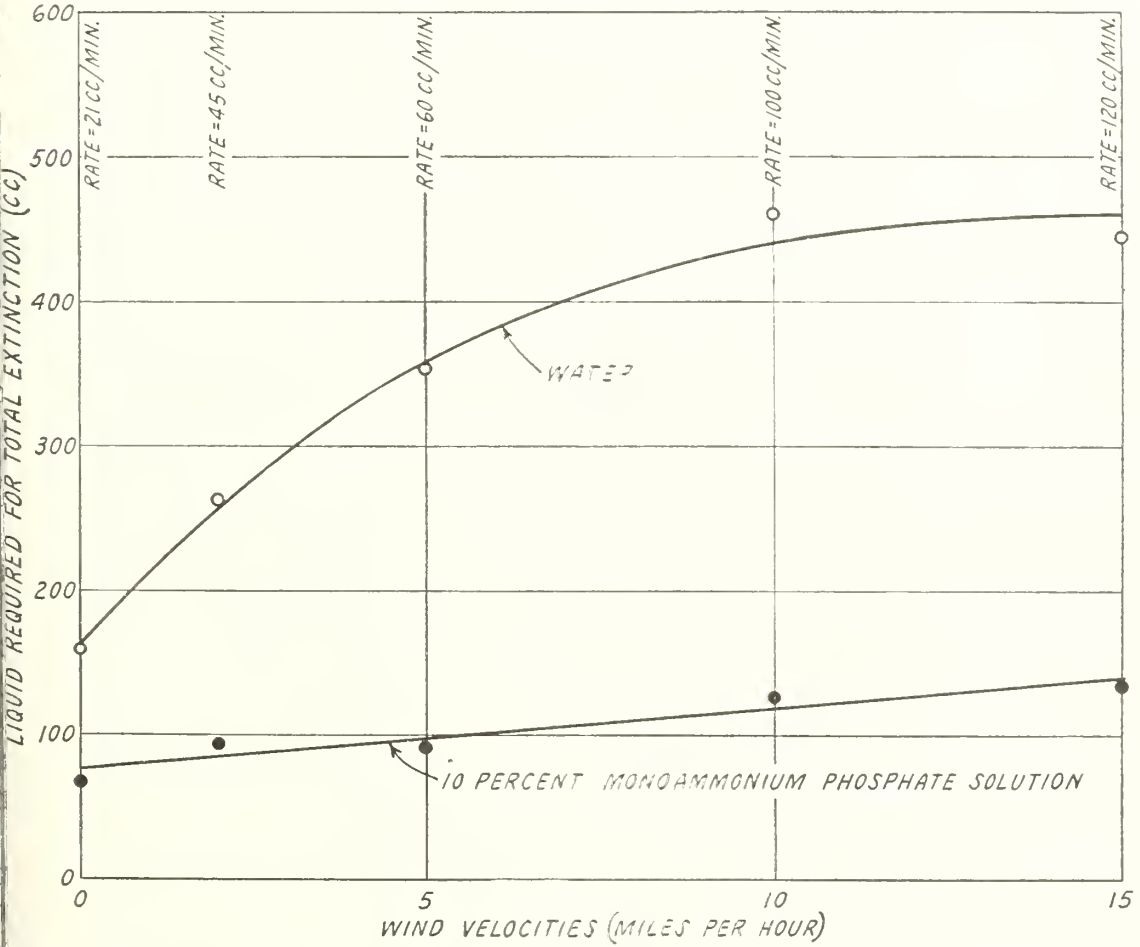
Relation between total extinction volume superiority factors and the concent tion of monoammonium phosphate solution.

water is small and fairly constant. With lower rates of applicat the amount of water required for total extinction increases rapid whereas the amount of chemical solution decreases slightly. At lowest rate of application, more than four times as much water as percent monoammonium phosphate was used for total extincti At still lower rates it was impossible to extinguish the fire with wa before the crib collapsed. This series of tests shows rather clea that the superiority of a chemical solution over water is not a c stant, but is related to the rate of application of extinguisher fo relatively constant size and severity of fire.

It became evident during the course of the investigation, par ularly in the field tests, that wind velocity was an important fac in extinguishing and that the relative effectiveness of chemical so tions and water might change when tested under substantial w conditions. Consequently, late in the course of the study, so laboratory tests were made under constant and controlled horizo wind velocities. A 10-percent solution of monoammonium phosph



e variation in volume of 10 percent monoammonium phosphate solution and water required for total extinction, with change in rate of application.



erage amount of water and of 10 percent monoammonium phosphate solution required for total extinction at different wind velocities.

was compared with water on wood crib fires under wind velociti of 0, 2, 5, 10, and 15 miles per hour. With increasing wind velociti it became necessary to increase the rate of application of liquid order to extinguish the fire. The rates of application used in o series of tests were selected, after some preliminary work, to obta approximately the same weights of crib residues (amount of fu remaining after extinguishing). In the other series of tests a relative high rate of application was used throughout. The results are sho in table 2 and a part are presented graphically in figure 3, in which t volumes of liquid required for total extinction are plotted agai wind velocity.

Table 2.—*Effect of wind velocity on fire extinction superiority of 10 percent mo ammonium phosphate solution over water*

Number of tests averaged	Wind velocity	Rate of application	Superiority, factors		Crib residue (percent of original crib weight)	
			Flame extinction	Total extinction	Extinguishing agent: water	Extinguishing agent: chemical
	Miles per hour	*Cc. per minute*			*Percent*	*Percent*
5	15	120	4.5	3.3	31	38
5	10	100	4.3	3.6	32	42
5	5	60	3.3	3.7	32	42
5	2	45	2.3	3.1	31	39
5	0	21	1.3	2.1	28	34
5	15	100	5.0	4.0	18	37
5	10	100	4.3	3.6	32	42
----------	0	100	1.0	1.1	47	49

It is at once apparent that the superiority of the monoammoni phosphate solution over water increases with an increase in wind locity. With velocities of 10 and 15 miles per hour it required so three and one-half to four times as much water as chemical solut to extinguish the fire. Had it been possible to extinguish the fi with water at lower rates of application the superiority of the chemi solution would doubtless have been still larger.

This series of tests indicates that wind velocity has a major effect the size of superiority factors of chemical solutions over water, that values obtained for the various chemicals tested in quiet air (ta 2) do not apply under appreciable wind velocities. A considera number of the chemicals tested, particularly those that showed h total (flame and glow) extinction properties, as illustrated by mono monium phosphate, would be expected to show increased effective with increased wind velocities. Apparently the flame extinction su riority of chemical is related to its glow extinction property un substantial wind velocities. Although flame may be temporarily ex guished, the glowing fuel is quickly fanned into flame again by a s stantial wind, unless the chemical exhibits marked glow extinct properties. Since field fires are commonly accompanied by strong currents, it appears that the superiority for total extinction is of m greater practical significance for most field fires than superiority flame extinction alone.

During the progress of the investigations it was learned that M (4) working in Germany and using similar laboratory test proced had tested a group of 10 chemicals that were included in the Fo roducts Laboratory tests. A comparison of the results of the two idependent investigations shows a similar order of effectiveness for ie 10 chemicals. Metz also found ammonium phosphate the most fective of the several materials tried.

Field Tests

The laboratory tests gave valuable indications of the comparative fectiveness of a considerable number of chemicals under rather refully controlled conditions. In the laboratory it was possible to ry the rate of application to the size and severity of the standard e, to approach the minimum rate and quantity required for extinc- on without danger of the fire getting out of control, and to apply all quids to fires similarly and with little waste; objectives which could ot be attained so well under field conditions.

The laboratory tests, however, were confined to a single type, size, id arrangement of fuel of approximately uniform moisture content. onsequently, it was considered desirable to check the laboratory sults for a few of the most promising chemicals on the more impor- nt forest fuels and as much as possible in their natural arrangement id condition, by different methods of application.

A total of more than 2,000 field tests were made on grass and pal- etto-grass fuels of the South; hardwood leaf litter of the Appalachian gion; slashings of the Lake States, Appalachian, and Pacific North- est; logs and branches, bracken, and rotten wood of the Pacific orthwest; and pine duff and brush of California. In each of these rious regions, the local Forest Service experiment stations and ministrative units cooperated in making the field tests.

Where it was feasible and practicable, the fires were set in the fuels their natural arrangement and condition. This was true for all sts in grass, palmetto-grass, hardwood leaf litter, pine duff, and brush. ishings, logs and branches, bracken, and rotten wood were arti- ially arranged, however, either because of their nonuniform natural stribution or on account of the danger connected with burning them their natural arrangement under the conditions prevailing at the ie of test.

Chemicals for field tests were selected on the basis of their showing the laboratory tests. Phosphoric acid and its monoammonium and mmonium salts had shown the highest total extinction effectiveness rough a wide range of concentration. Of this group the monoam- nium phosphate was used on all fuels tested in the field. Ammon- n sulphate was included in the field tests on a number of fuels be- use of its moderate effectiveness and low cost. Either the bicar- nate or the carbonate of potassium, both of which had shown high me extinction properties in the laboratory, was used on those fuels which the flaming type of combustion seemed to predominate. In later series of tests some work was done with foams. Field tests ene or more fuels were also made with calcium chloride, boric acid, osphoric acid, and sodium acetate.

The procedure used in the field tests was modified from time to ie as the work progressed, experience was gained, and additional iipment became available. For most of the tests an experimental t, consisting essentially of a small air compressor, pressure tanks for iids, hose and nozzles, was employed. A number of types of nozzles were used, but one adjustable over a wide range in rate of flow liquid was employed extensively in the field tests. In some tests bac packs were used, and in a few tests power pump equipment w employed. These were all included in a portable field laborato containing a variety of equipment for preparing and applying solutio and foams and taking the measurements and data required.

In the early field tests, alternate fires were extinguished wi chemical solution and water, respectively. Considerable difficul was experienced, however, in obtaining successive fires of equ severity, because of wind conditions at the time of test and oth factors. A method of making two tests simultaneously—one wi chemical solution and one with water—was finally evolved in t later experiments. This method overcame the irregularity due wind. The two fires started at the same time were extinguish simultaneously by two operators with similar equipment, one usi water and the other chemical solution. For succeeding tests, t operators alternated water and chemical solution regularly, ea extinguishing the same number of fires with each liquid in a seri of tests.

The data taken varied somewhat from one series of tests to t next. However, in all tests the quantities of liquids used for knoc ing-down the flame and mopping-up the glow, and the elapsed ti occurring during extinction were recorded. In the naturally arrang fuels, measurements were commonly made of the length of the exti guished line or the areas burned. Readings were also made of weath conditions, including temperature, relative humidity, and wind veloci and direction. In some cases, moisture contents of fuels we determined.

Considerable care was exercised to have fires of comparable si and severity for extinguishing with water and chemical soluti Areas of naturally arranged fuels were selected to obtain as mu uniformity as possible. Artificially piled fuels were selected to g uniform kinds and quantities of material and to have them arrang in like manner for corresponding water and chemicals fires. With the care used, however, it was felt that large differences were comm in the test fires, particularly in the naturally arranged fuels. Furth more, no constant relation between rate of application of liquid a size of successive fires could be attained, and the wind velocity a direction fluctuated considerably, both during a single test and fr one fire to the next. These variations caused wide fluctuations in results in successive tests and series of tests that were intended to alike.

In table 3 are shown the average results obtained in the numer field tests on different fuels with several chemical solutions and foa The values, shown as superiority factors, are similar to those used express the results of the laboratory tests, and represent the ratio quantities of water and chemical solution required for total extinct of test fires. For example, a factor of 1.5 indicates that 50 perc more water was used than chemical solution in extinguishing the fires. A range of values, as 1.2 to 1.6, indicates that the results var as shown in different series of tests made at different times and un somewhat different conditions.

While there are definite limitations to the data because of n uniform test conditions, certain important indications are nevert s evident. Chemical solutions and foams show different results on ferent fuels. The flame extinguishing types of chemicals, such as e bicarbonate and carbonate of potassium, made their best showing the flashy types of fuels, like standing grass and loose hardwood ves, and were of little or no benefit on the glowing types of fuels, e slashings and closely compacted pine duff. On the other hand, e pronounced glow-retardant chemicals, of which monoammonium osphate was selected as representative, were most effective on the wing types or combinations of glowing and flashy types of fuels, ch as fresh pine slashings, but showed substantially increased ectiveness over water on all fuels tried, except rotten wood. Foams re of most value on logs and branches and rotten wood, where the rning surfaces could be coated with a continuous layer of the foam. green slashings, bracken, and similar materials, where the fuel is ck and matted, the foam cannot be applied readily to the burning rfaces and has little or no advantage over water. In general, the st results with foam were obtained when the combined foam-rming and fire-retardant chemical solutions were expelled as a uid or as a partially expanded foam. Considering the range of fuels d concentrations of solutions tested, monoammonium phosphate was e most effective material tested. Furthermore, it is moderate in st, appears to be otherwise suitable, and is the most widely applicable.

BLE 3.—*Comparative effectiveness of chemical solutions and foams in direct extinction field tests*

Extinguisher		Superiority factors [1] based on volumes of water and chemical solutions used for total extinction on—								
Chemical	Concentration	Grass	Palmetto-grass	Hardwood leaves	Pine duff	Coniferous slashings	Logs and branches	Bracken	Brush	Rotten wood
	Pct.									
monium phosphate, ono-.	2.5	1.2		1.3		1.2–1.6				
	5.0	1.3–1.5	1.6	1.4		1.4–2.1				
	7.5	1.4				1.5				
	10.0	1.5		1.5	1.8	1.5–2.4	1.3–1.5	1.4	1.5	1.1
monium sulphate	5.0	1.3		1.2		1.3				
	10.0	1.1	1.2	1.3	1.3	1.4–1.6				
	15.0					1.5				
ic acid	2.5					1.2				
	4.0					1.4				
cium chloride	10.0			1.3		1.3				
	20.0					1.8				
sphoric acid	5.0	1.4								
assium bicarbonate	5.0	1.2			.6					
	10.0	1.4								
assium carbonate	5.0	1.2	1.3	1.3		1.0				
	10.0									
ium acetate	5.0	1.2								
m not loaded [2] expelled as iquid	9.0						1.2			
m loaded [2] expelled fully panded	16.4				.5–.8	.7	.7			
m loaded [2] expelled as a uid	16.4				1.1	1.1	1.6	1.1	1.4	1.6
n, Kempak (loaded)	18.8				1.2–1.5	1.3	1.3			

---

uperiority factors calculated by dividing volume of water by volume of chemical solution used in ly extinguishing similar fires. Different procedures were employed in conducting tests on the different so that the values shown are not entirely comparable in all cases.

Not loaded" foam contained only foam-forming chemicals; "loaded" foams contained approximately l amounts of foam-forming chemicals and fire-retardant chemicals.

Pretreatment Tests

Field tests were also made in which the fuels were pretreated i advance of an oncoming fire. These tests were made in several way to determine the value of chemicals in holding a line from which t backfire, or as a barrier or firebreak. Of the chemicals tried, phos phoric acid and its ammonium salts were found most effective. I pretreated strips of grass and pine duff, in which the water was allowe to evaporate before test, moderately severe fires were completel stopped by the fire-retardant chemical. Lines, freshly treated wit monoammonium phosphate solution and from which back fires wer set, were much more easily held than lines treated with water alon

Summary

The results of both laboratory and field tests show that the exti guishing capacity of water can be increased or reinforced materiall by the addition of certain chemicals, the increase depending upon bot the kind of chemical and its concentration in the solution.

The superiority of a given chemical and concentration of solutio over water is not a constant, but varies with a number of factors, which (*a*) the rate of application in relation to the size and severit of the fire, (*b*) the wind velocity, and (*c*) the kind and arrangement fuel are important. Dependent upon the conditions prevailing, th amount of chemical solution required may range from approximate the same as water to only a small part of the amount of water require to extinguish a fire.

Of the various chemicals and foams tested, monoammoniu phosphate solution appears thus far to be the most practical a promising, all things considered, for most types of forest fuels.

Where an abundant supply of water is available and can be use chemicals are not considered to have any worthwhile applicatio Where water is scarce or difficult to get to the fire, or where the ava able equipment is scarcely adequate to cope with the fire, the intellige use of chemicals can yield important advantages. In border-li cases, chemical solution may control or hold a fire where water fai and chemicals may, in such cases, make all the difference betwe success and failure in an attack upon a forest fire. The use of chem cals appears most important in the early or initial stages of attac through the use of back packs and tankers, and they probably ha little if any application on large going fires, unless for use when ba firing.

It is realized that only a few of the many chemical materials a methods of application have been investigated and that further search in the field may yield valuable results. However, miraculo results with chemicals are not to be expected nor are chemicals equa effective under all forest fire conditions. Furthermore, to util present known fire-retarding and extinguishing chemicals efficient further studies are needed to develop or adapt apparatus and metho for their application. It is believed, however, that the work thus points the way to a new and useful weapon for the forest-fire figh that will ultimately assist him in his never-ending fight against fi

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Quick Get-Aways.—At F–32, C. C. C. camp at Mayhill on the Lincoln National
est recently a group was walking back to the camp office when without warning
erintendent Ray Craig turned loose a series of shrill blasts on his whistle. A
en enrollees came pouring out of the camp shops, from off a camp trailer under
struction nearby, from around nearby buildings, some hatless, others with
t-tails flapping, but all with one objective—to get up the steps and into the
truck. In less than 30 seconds by the watch the driver was in the seat, the
tor turning over, and in just 45 seconds Project Assistant Ray Stoddard had
hed up the tail gate, grabbed the open door of the cab and the truck rolled out,
h its trained fire crew, its full equipment of tools and rations for 20 men, and its
flags at all four corners warning road traffic that the Mayhill fire truck was on
way to keep another Sacramento Mountain fire in class A. The next morning
ther demonstration, this time a real fire up the Penasco, saw the big Dodge
ke body truck hit the camp exit in about 55 seconds. Said the regional office
tor, "Huh, I'd have been a sucker to have bet even a hat band against that
fit on as little as a 1-minute getaway."—Region 3 Daily Bulletin.

RANDOM NEWS NOTES FROM THE FOREST SERVICE RADIO LABORATORY

Contacts with forest officers generally indicate that even those within the region where the Radio Laboratory is located have little idea of the proposed and current work and progress of this Service-wide project. It is planned, therefore, to include in each issue of Fire Control Notes a news letter from the Radio Laboratory, as a means of distributing information of value to users of radio. It should also prove useful in communication planning and in anticipating the application of new designs and improvements.

Automatic Ultra High Frequency Relaying

It is now common knowledge among Forest Service radio users th transmission by ultra high frequency radio (represented by the typ A, S, SV, T, and U) is largely limited by topographic barriers. Th radio-minded individual, when standing on top of a mountain or oth prominence, will usually visualize the tremendous communicatio possibilities from such a point with even the lowest powered type ultra high frequency radio transmitter. For general communicatio purposes it is seldom possible to take advantage of these ideal topo graphic conditions. Over four years ago the Radio Laboratory d cided that something should be done to permit the use of these ide locations even when not regularly occupied by lookouts or firemen

The best possibility of making use of these ideal topographic spo would be to equip them with some form of automatic relaying devi which would permit picking up messages from portable stations in th field and retransmitting the message to some distant terminal statio in sight of the relay point. Such an arrangement would add tr mendously to the possibility of applying ultra high frequency equi ment to general communication needs.

Because of the complications involved and the relatively hea battery drains necessary to operate such an automatic relay syste the idea was not actively investigated until early in 1939. Com mercial systems employing the automatic relay feature have been operation for several years. All of these rely upon commercial powe however, and they are so complicated and their mode of operation such that they are entirely unsuited to Forest Service use.

Since practically all points which are best suited for the establis ment of an automatic relay station would be without commerci power, one of the prime requisites of such a system for field use reduction of dry battery consumption to an absolute minimu Recent developments in the field of commercial vacuum tubes ha permitted exceptionally large savings along this line, and the fir automatic unit is now under test at the Radio Laboratory. Natural many of the solutions of problems encountered in considering oth ultra high frequency problems have been applied to this test un with the result that the automatic portion of the device is mu simpler than might be expected. Several improvements must yet made before the system will operate with a high degree of reliabilit however, and it is not expected that the automatic relay will be rea for release to the field for at least 1 year.

The present type S radiophones cannot be satisfactorily used work into an automatic relay system, because, in order to talk throu the relay station it is, of course, necessary to transmit on the fi quency to which the relay receiver is tuned. It has been generally agreed by field technicians that the type S radiophone should be revised in several minor points, and in making these revisions some method of tuning the transmitter will be provided to permit working into the proposed automatic system as well as to simplify the method now necessary in calling the new type T model D radiophone.

For those interested in the technicalities of the proposed relay device, a brief discussion of the functioning of the unit now undergoing test is given.

The transmitter and receiver proper of the test unit are fundamentally duplicates of those portions of the new type T model D radiophone. Each part, however, has been built as a separate unit to facilitate experimental alterations. The local oscillator of the superheterodyne receiver has been crystal controlled on the standby frequency. The automatic control device is mounted on a third unit and consists of an open chassis about 6 by 8 by 2 inches, which carries three tubes and five relays.

In order to conserve batteries to the utmost, the receiver does not operate continuously, but is turned on for 5 seconds out of each half minute by means of a weight driven clock. If a carrier of 6 microvolts or greater is present on the receiver standby frequency during the 5-second "on" period, the receiver automatically locks into continuous operation and the relay transmitter comes on the air retransmitting any signal which may be coming into the receiver.

In order that the entire circuit shall not be interrupted during the switchover time between terminal stations, when operating simplex, a time delay of 10 seconds has been provided; i. e., the relay station remains in operation for 10 seconds after the incoming signal has been discontinued. This arrangement allows adequate time for each terminal station to come on the air and hold the relay system in operation without waiting for the receiver to recycle each half minute.

The total battery drain during each 5-second period is 200 ma. at 3 volts, 50 ma. at 1.5 volts, and 18 ma. at 180 volts. Without an incoming signal the relay station consumes the above battery power for a total time of only 4 hours out of every 24.

Unless the relay circuit is required to handle an exceptionally large amount of traffic, it is estimated that the device should operate for a period of from 2 to 3 months without attention or replacement of batteries.

Current Projects—Radio Laboratory

Design of mobile ultra high frequency receiver.—A thorough investigation of commercial receivers for mobile service in this frequency range has failed to disclose a satisfactory unit. The principal problems of this project are the production of a receiver having a tuning range of from 31.5 to 39 megacycles, yet one which is not critical of adjustment over this relatively wide range; the reduction of ignition interference below an objectionable level both from the car in which the receiver is mounted and from other vehicles on the road; the development of a receiver which will permit reception of equipment such as the type S radiophone (standard commercial superheterodyne receivers cannot be used to receive the type S because of frequency modulation of the transmitter); and the creation of a mechanical design which will retain adjustment of all circuits when the receiver is subjected to severe road vibration.

Design of a substitute for the present type U radiophone.—A greater number of AC operated ultra high frequency radiophones are needed in the field, but because of the relatively high cost of the present type U the purchase of this unit can seldom be justified. The new type U will be similar in appearance to the newest type M and will incorporate a special receiver based on the design of the mobile receiver referred to above. The receiver will be equipped with an automatic calling device, which will eliminate the need of a noisy loudspeaker in constant operation for stand-by.

Preparation of data on five questions of the CCIR Stockholm meeting 1940.—This project involves making numerous technical performance measurements on Forest Service type radiophones. Such data are being submitted by the Department of Agriculture to the United States delegation to the International meeting at Stockholm in 1940. This material, together with that accumulated from other agencies, is used in the basic consideration of radio frequency assignments and performance standards throughout the world.

Design of a metal detecting device for use on saw timber.—The NETSA in New England has a serious problem in milling timber in which are embedded numerous metal objects which have destroyed saws and endangered the lives of sawyers and other head rig workers. The laboratory is investigating the possibility of producing a suitable detector to locate such embedded metal.

Projects for Early Attention—Radio Laboratory

Redesign type S radiophone.—Field technicians have generally agreed that the type S radiophone should be redesigned in several minor points. In addition to several technical alterations, it is proposed to repackage the type S to permit easier and more convenient handling in the field. The new type S will also incorporate some form of transmitter frequency control or monitoring which will permit setting the radiophone on some predetermined frequency. This latter feature is essential for operation into such equipment as the proposed automatic relay and will expedite calls to the new type T. Such a frequency marker device will also be useful in establishing contact with other type S or SV sets.

Antenna and transmission line investigation for UHF.—This is a continuing project, and any improvements in this part of a radio system can be considered equivalent to increasing the power of a transmitter or improving the sensitivity of a receiver. Special low angle arrays of rugged and simple construction will be one of the important considerations investigated.

Honorable Mention Department.—The absence of the Clark National Forest in the list of forests having fires over 300 acres in 1938 was immediately noticed in Washington. In 1936 this forest had 15 fires over 500 acres burning a total of 18,350. In 1937 there were 8 fires over 300 acres burning 4,975 acres. In 1938 not one single fire over 300 acres!

BI-STATE BODY PLANS CAMPAIGN TO REDUCE FOREST-FIRE LOSSES

Woods and mill workers have not been without some appreciation of what forest protection means to them. In many cases they have been more conscious of their stake in forest-fire control and sustained yield than were timberland owners. But organizations of woods and mill workers have seldom given aggressive support to the movement to preserve and renew the raw material on which the security of their members depends. The following clipping from the Union Register, a labor paper of Seattle, sent in by Assistant Regional Forester John C. Kuhns, may therefore have a far reaching significance. It is hard to imagine a more potent force for fire prevention than a great body of organized workers fully conscious of how much forest protection means to their class and determined that carelessness and neglect shall not jeopardize the forest on which their future security depends.

Reforestation and perpetuation of the lumber industry have become recent years one of the major concerns of the Lumber and Sawmill orkers Union. The men in the mills and woods are becoming in- easingly cognizant of need for building not only for the present t also for the future.

Fire has always been the greatest threat to perpetuation of our vast mber resources. Unless fire is curbed, all the efforts to establish stained yield, selective logging, strip logging, or reforestation are llified. Forest fires must be held to a minimum if Washington and regon are to escape the fate of Michigan and the Lake States which ve become barren scrub-covered areas instead of heavily timbered, mber producing States.

The Oregon-Washington Council of Lumber and Sawmill Workers is king the initiative in working out a program to stamp out the rrific annual toll due to forest fires. Through the Union Register, rough posters, and windshield stickers, the bi-State body is going impress on the public the necessity of reducing the number of forest es.

The campaign will be carried on all summer. Lumber workers ill be urged to help educate the general public in the need for more re in the woods.

Tangible results are expected to be forthcoming this summer, al- ough the campaign is laid out on a long term basis. Over a period of ears, the efforts of the Oregon-Washington Council will undoubtedly much to help reduce the huge annual losses due to carelessness in e woods.

Boy Scouts as Carriers of Fire Prevention.—Mr. Hugh Fleming, Jr., now with e New England Forest Emergency organization, writes from Boston that 70,000 y Scouts will each spend a week in camp during the summer. Every Sunday orning when a group is being sent home, a short talk on fire prevention is given the Scout Master and two or more Flagg posters are given each boy—one for mself, and one or more to put up in his home town where he thinks it will do the ost good. The Boy Scout organization is divided into regions similar to Forest rvice regions, and anyone interested in promoting a similar movement can get in uch with the regional officials of the Boy Scouts by inquiring from the nearest y Scout Master.

SEEN-AREA MAPPING—AN IMPROVED TECHNIQUE

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A technique of seen-area[1] mapping, making use of a cover-typ map, the Osborne fire finder or a vertical angle measuring alidad binoculars, and an elevation—unseen-space scale, has been tried ou on the Upper Michigan National Forest and found to produce astonishingly accurate and consistent results.

On this forest a lack of contour maps and a semiflat topograph makes profile plotting, whether in the office or in the field, unfeasibl Through necessity, sketching from the tower is the only metho used, all work heretofore being done on ½-inch=1 mile scale bas maps.

View northwest from Tie Hill Tower, Upper Michigan National Forest. Th hills in the immediate foreground are 250 feet above the lakes, those in th background nearly as high. Note the landmarks, cover types, and lakes.

Past experience indicates that these maps lacks detail necessary i seen-area mapping. Their use has produced annually a crop o sketches so optimistic as to be valueless in detection planning.

Since admitting the weaknesses of our detection system is the firs step in correcting its faults, the present technique is designed to ma as unseen all areas not *surely* seen. At the same time, no attempt i made in the field to speculate on the relative depth of the unsee eas, since without contour maps this would degenerate into pure lesswork. Rather, the mapper shows as nearly as possible what he es, not what he thinks, in order that the planner may *start* with cts.

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[1] Seen area, throughout this article, means any portion of a 10-mile circle visible to the lookout and ma consist of treetops, low shrubs, or ground cover. Any area hidden from the lookout, by being below h line of sight, regardless of how far, is technically unseen.

Four things have been found necessary to good seen-area mapping:

1. A detailed map giving the accurate [2] location of a large number landmarks easily recognized from a fire tower. Topographic symols, or some indication of topography, are vitally necessary.

2. An instrument, either the Osborne fire finder or an alidade, to able the observer to sketch the width of the unseen areas, and easure vertical angles.

3. Binoculars, to aid the observer in noting and locating ridges or her masks [3] and in recognizing landmarks.

4. A method for determining the length of the unseen area, which ill work in semiflat topography and which does not require contour aps.

On Upper Michigan the forest inventory township plats have oved the most suitable map for this work. These plats indicate all ver types over 2½ acres, carry base from aerial photographs, road d lake traverses, and, in addition, show many hills, ridges, and her topographical features.

Normally, these maps are on a scale of 4 inches=1 mile, but for is purpose, photostatic blue-line prints, on a scale of 1 inch=1 mile, ve been obtained. These prints are mounted on cloth to form a osaic for each tower or point mapped. In actual practice the mosaic trimmed to a circle with a 10-mile radius and temporarily mounted the fire finder by means of Scotch tape.

This preference for timber-type maps as a base in seen-area mapping ould perhaps be further explained.

Since the topography in this part of the country is relatively flat, many parts of the forest a stand of timber 70 feet high may prove much of a mask as a hill or may double the height of an existing ll. It is, therefore, imperative to be able to locate on the map all ands of mature timber.

Timber types on this forest consist of a number of coniferous and eciduous associations which change character at a slight variation soil or moisture, but which appear consistently in the same topoaphical locations. While this natural ecology may be somewhat tered by cutting and fire, it can be accepted that a species charactertic of a swamp will not usually be found in large numbers on a ridge. nce most field men can be trained to recognize through binoculars aracteristic species at several miles distance, a good type map not ly furnishes the location of many recognizable landmarks but offers excellent key to the topography.

The illustration on page 20 represents the procedure which might followed in determining the location of a mask and the width of s unseen area, using a type map.

The upper sketch represents the appearance of the landscape to e mapper, the lower the type map.

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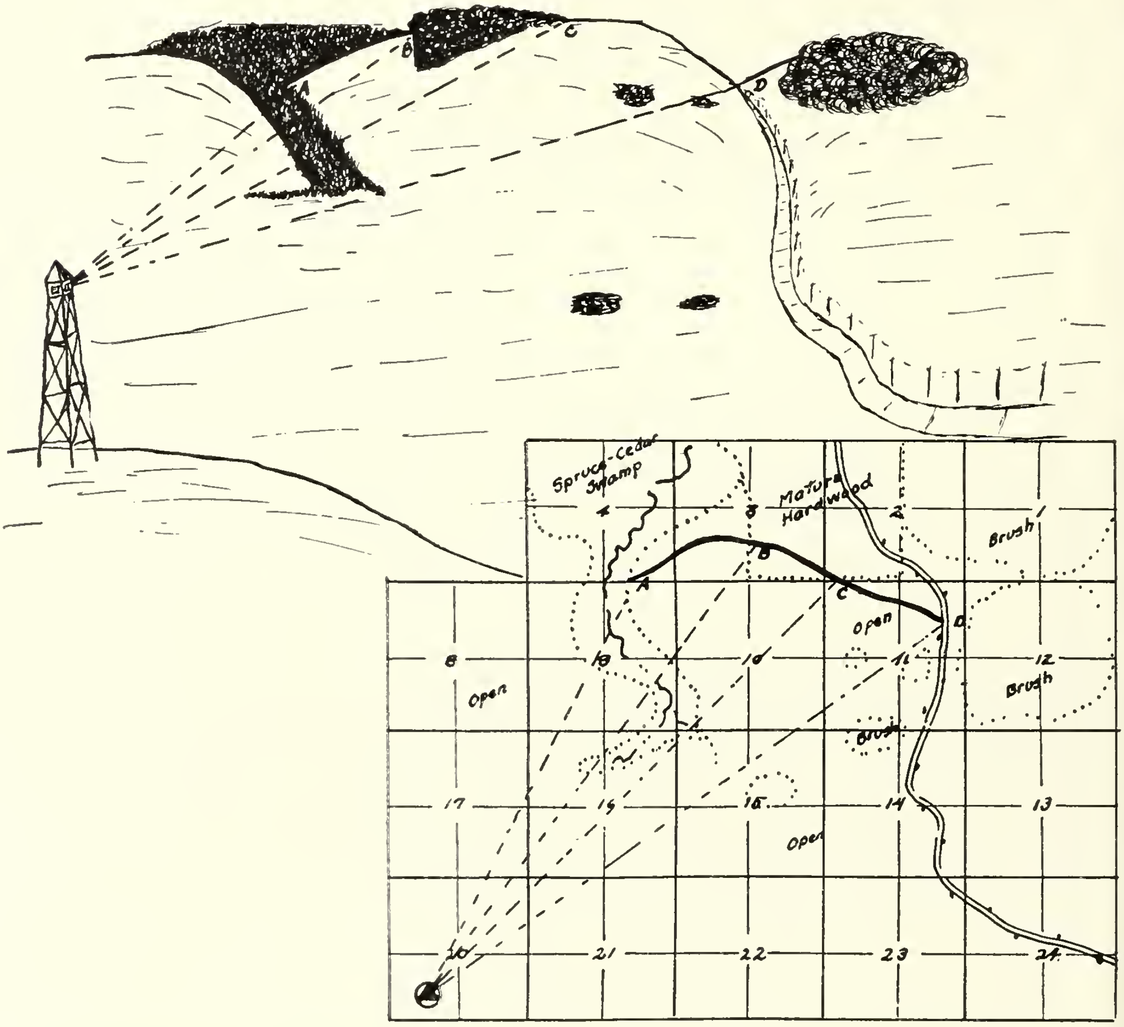
[2] While this term is relative, base features should be located within 200 feet of their true position.

[3] For the purpose of this article, the word "mask" may be taken to mean any hill, timber, or other feature structing the observer's view.

A represents the point where the hill appears to come in contac with the swamp along the creek, *B* the left edge of a block of matur hardwood near the crest, *C* the point where the timber disappear over the hill, and *D* the spot where the road comes around the righ edge of the hill. By sighting on each point and drawing rays as indicated to the known landmarks, the crest of the hill line *ABCD* i plotted. The outer rays *OA* and *OD*, projected, mark the extrem width of the unseen area.



Sketch and map illustrating use of type map in locating crest of ridges.

But the determination of the length [4] of the unseen area is not quit so simple. One method commonly used may be called the landmar. method. The observer in this case, having located the crest of th hill, picks out a landmark which appears directly above it. Thi landmark, building, road, lake, or other feature, marks the extrem edge of the unseen area. (See illustration, p. 21.) In this sketcl *A* indicates the junction of the unseen area and the railroad, *B* th edge of a field appearing just over the crest of the mask, *C* the poin where the left edge of the unseen area crosses the railroad and *D* th intersection of the hill and road. On the map the crosshatched are *ABCD* indicates the unseen area as it would be shown.

In timbered country the type map unquestionably offers the bes means of locating a large number of landmarks necessary to th system described, while in settled areas it proves almost as valuabl in showing the location of scattered woodlots. In addition, it offe this further check: if the observer in a country where hardwoo idges and coniferous swamps exist is able to see only the tops of ardwood trees from the tower, he may surmise that part of the area s unseen, yet not know what part. On the other hand, equip him ith a type map and he will know how much is unseen and its ocation.

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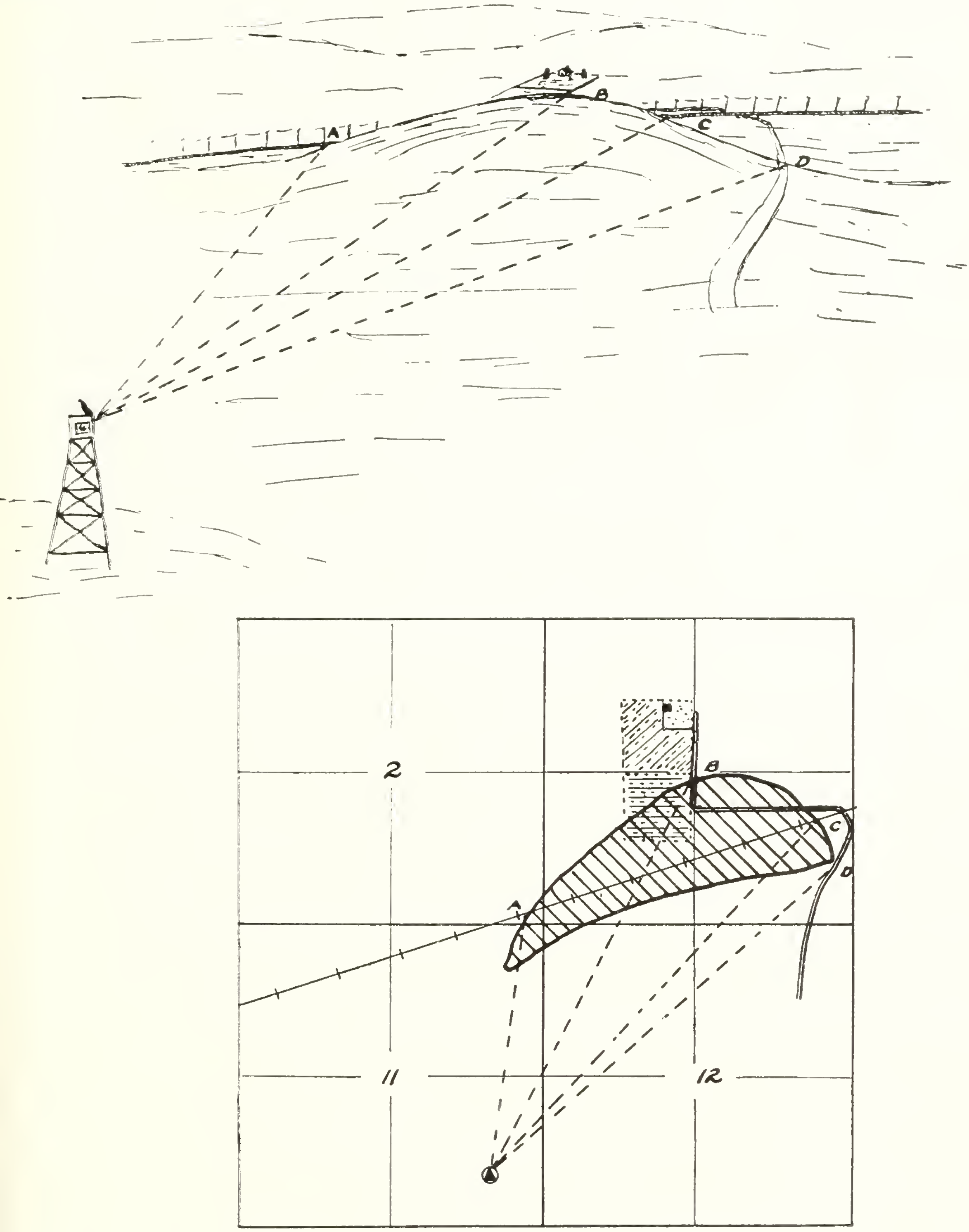
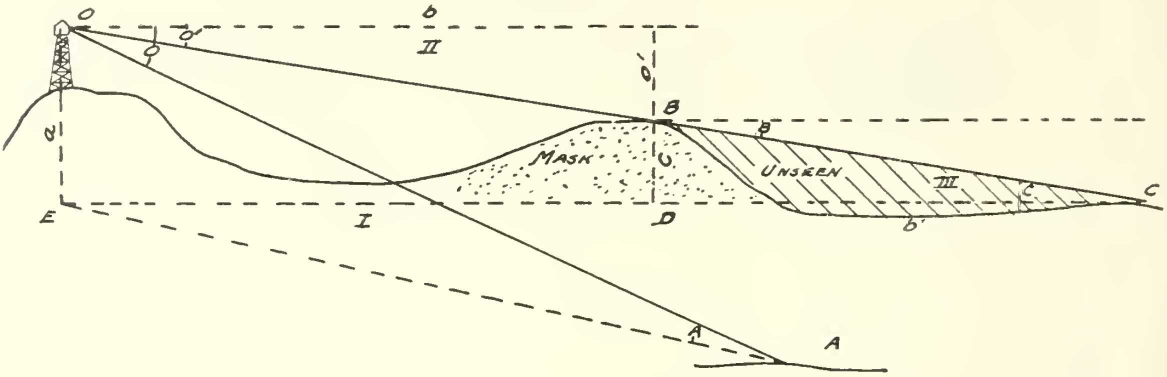
[4] The distance unseen behind the hill.



ketch and map illustrating the landmark method of determining outlines of unseen area behind a mask.

Needless to say, binoculars are indispensable to accurate work. requently an area which appears solid to the naked eye may show p as a series of rounded ridges when viewed through the glasses. Ve cannot afford to let the optical illusions created by the lack of roper equipment influence the planning of our detection system.

In all of this work the fire finder or the alidade must be used con-inually to locate points and to plot edges of masks and the resulting unseen areas. But there is another important use for these instruments: the reading of vertical angles. For, ideal as the landmark system may appear to be it fails miserably in some circumstances. Where unseen areas fall on jackpine-blueberry plains, cedar-spruce swamps, muskegs, or consistent level hardwood stands, the monotonous landscape offers few effective landmarks. Here the mapper has a choice of guessing at the length of the unseen area, or attempting to work out some effective means of calculating the distance.



Mathematical explanation and proof of the angle-of-site method.
Let *O* be the observation point.
B be the crest of a mask, at a known location.
C be the unknown point where the observer's line of sight intersects the ground or ground cover.
A be a landmark of known location whose elevation is approximately that of *C*.
Vertical lines are constructed through points *O* and *B* and horizontal (level) lines constructed through *O*, *A*, *B*, and *C*, forming right triangles I, II, and III, with angle *A* equal to angle *O*, and angles *B* and *C* equal to angle *O'*.
Angles *O* and *O'* are negative vertical angles measurable from the tower. Lines *EA* and *b* are scaled directly from the map.

(1) Then $A=\frac{EA}{CotA}=\frac{EA}{CotO}$

(2) And $o'=\frac{b}{CotO'}$

(3) And $c=a'-o'$.

(4) And $b'=cCotC=cCotO'$.

(5) Therefore $b'=\left(\frac{EA}{CotO}-\frac{b}{CotO'}\right)CotO'$ =length of the blind area.

Where the height of the mask (*c*) can be estimated, length of the blind area = *cCotO'*.

In this proof the curvature of the earth has not been considered, since it was felt that this would be a negligible factor even at 10 miles distance.

Past experience on Upper Michigan has proved that the human eye is not an effective instrument for calculating horizontal distances where angles of less than 5° are involved. Since in this type of topography 90 percent of the vertical angles measured from any one tower are less than 2°, the chances of any individual training himself to consistently estimate the length of the unseen area behind hills of varying height at different distances are exceedingly remote.

Yet, at the same, time, these hills all rise less than 500 feet above the surrounding plains, in fact the average is closer to 100 feet. How much more effective would it then be for the observer to estimate the height of the hill (to the nearest 20 feet, let us say) and calculate by trigonometry the horizontal leg of the triangle? Roughly, on a hill 100 feet high with a vertical angle of 20 minutes the chances of an accurate guess would be 3,000 to 1 in favor of the latter method. Then if we further improve the technique by calculating the height of the hill, is it not likely that the method would prove the most accurate possible?

The angle-of-site method [5] developed on Upper Michigan calculates by trigonometric right triangle formulas the relative elevation of the top of the mask and the ground level behind it, then determines the length of the unseen area as one leg of a right triangle whose base is the difference in the above elevations and whose apex angle is equal to the negative angle of the top of the mask, read from the tower.

The illustration on p. 22, with its accompanying explanation, covers the formulae and procedure used in this mathematical solution. But accurate as this method is, it has one rather obvious weakness, the time required to complete the computations. Even if every field man called upon to make a seen-area map were a mathematical genius, the necessary time plus the possibility of arithmetical error would seriously discount the value of the system.

Realizing the necessity of making this technique practical, a simple scale was developed which reduces the procedure to the mere reading of vertical angles and the laying off of distances upon the map.

The above elevation—unseen space scale, shown above, consists of:

1. A 1 inch = 1 mile scale[6] graduated in miles and quarter miles.
2. A 1 inch = 1 mile space scale reading elevation in feet over unseen distance in miles for angles of 10 minute variation.

In using this scale on a typical problem (see illustration on p. 25), the mapper would:

1. Plot lines from tower at *O* to points *A*, *B*, *C*, *D*, *X*, and *Y* as shown, extending line *OB* beyond unknown point *E* at the far side of the unseen area. (Point *D* is located on a definite landmark, whose elevation is approximately the same as the level ground in the vicinity of *E*.)
2. Sketch the crest of the mask as line *XBY*.
3. Measure the negative vertical angles to *D* and *B*, recording them as 40 minutes and 30 minutes, respectively.
4. On the 40-minute scale (see fig. 5) lay off the map distance *OD* and read 210 feet, the elevation difference of the observing point and the landmark *D*.
5. On the 30-minute scale lay off the map distance *OB* and read 100 feet, the elevation difference of the observing point and the crest of the mask at *B*.
6. Since *E* and *D* were assumed to be of equal elevation the height of *B* above *E* equals 210 − 100 = 110 feet.
7. From the 30-minute scale obtain the distance equal to 100 feet and lay this off on the map as line *BE*, the length of the unseen area.
8. The cross-hatched unseen area *AXBYCE* would then be outlined.

In actual practice, a number of shots must be made for every mask, but the procedure followed is identical, except that the elevation of the mask can sometimes be estimated allowing the observer to cut out steps 4, 5, and 6.

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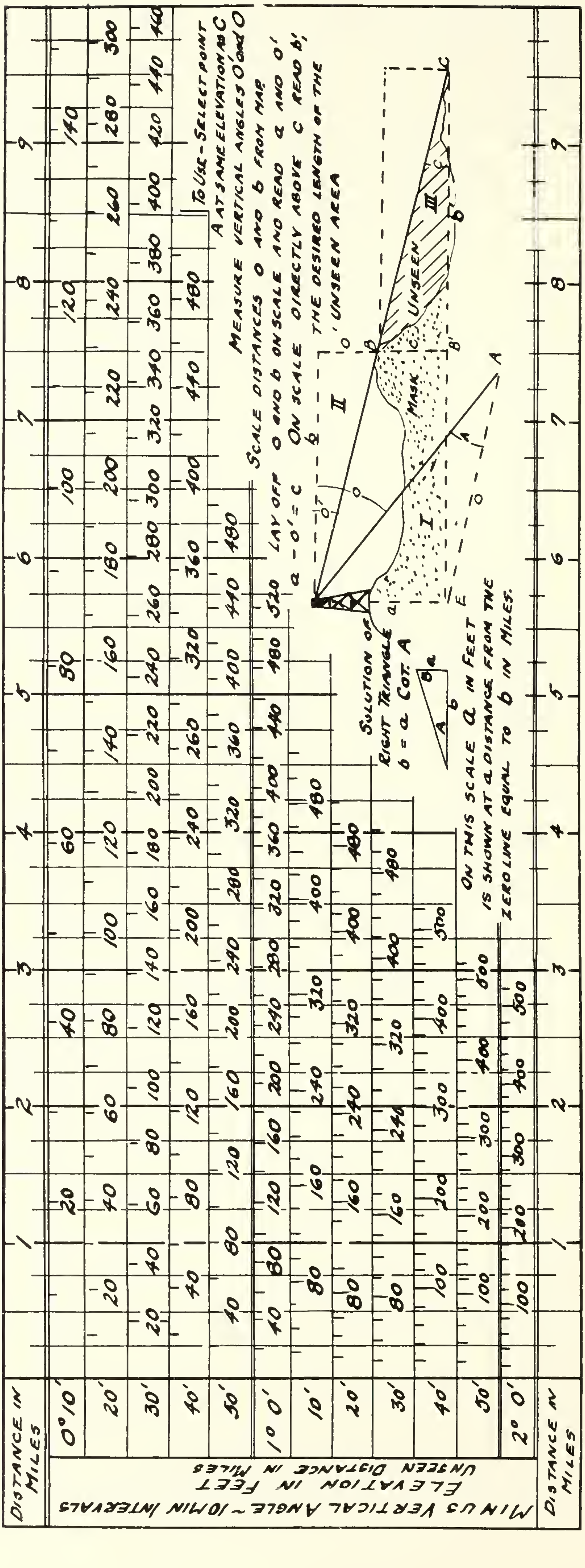
[5] So called because of its resemblance to the technique employed by the field artillery in computing the angle of site of a target hidden from the battery, but visible to the observers, in country where no contour maps exist.

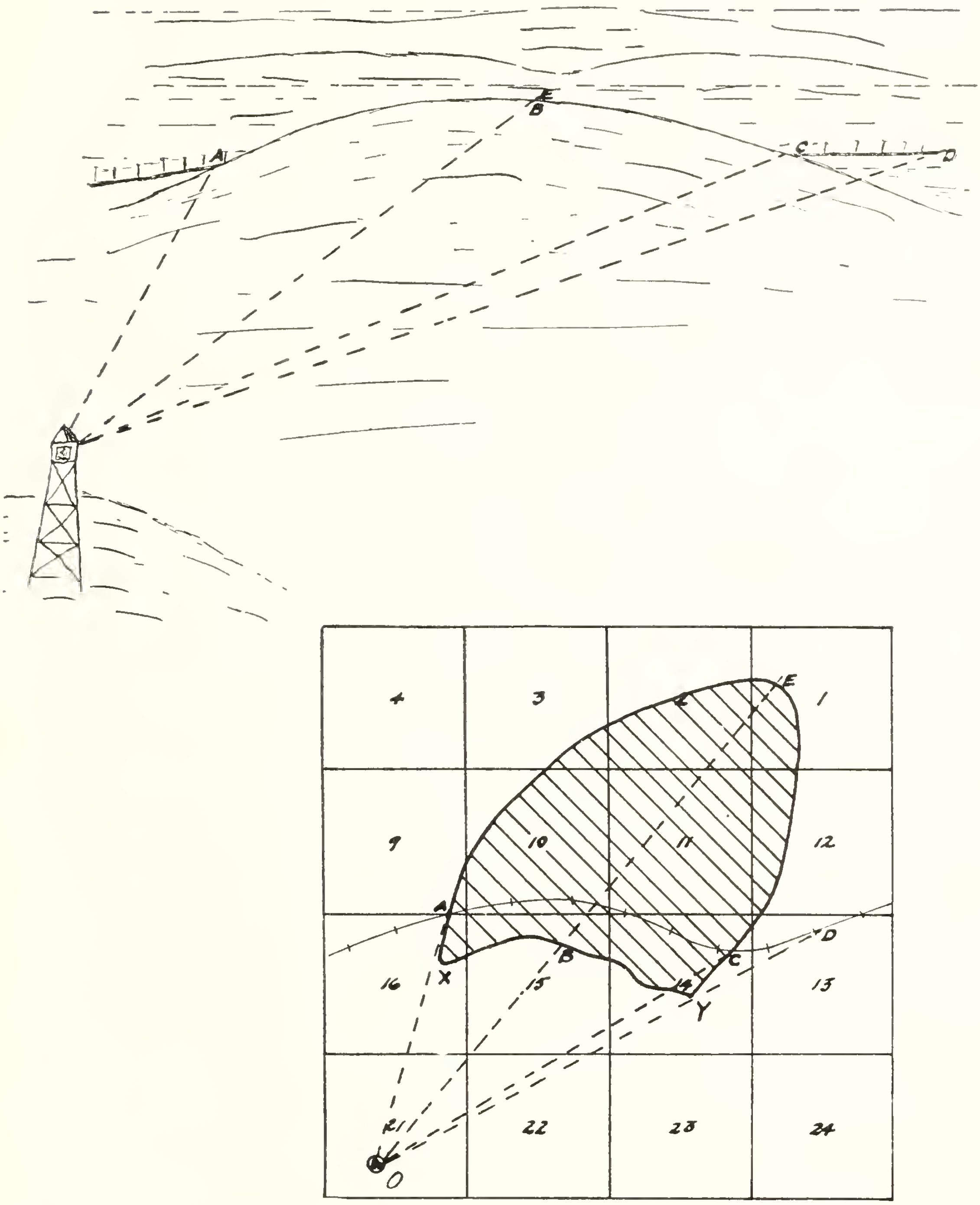
[6] Field mapping on Upper Michigan was done on a 1 inch = 1 mile scale map. The scale and the map must be the same.

ELEVATION-UNSEEN SPACE SCALE

CONSISTS OF ~ A 1 INCH = 1 MILE SCALE GRADUATED IN MILES AND QUARTER MILES.
A 1 INCH = 1 MILE SPACE SCALE READING ELEVATION IN FEET OVER DISTANCE IN MILES


DISTANCE IN MILES
MINUS VERTICAL ANGLE ~ 10 MIN INTERVALS
ELEVATION IN FEET
UNSEEN DISTANCE IN MILES
0°10'
20'
30'
40'
50'
1° 0'
10'
20'
30'
40'
50'
2° 0'
1
2
3
4
5
6
7
8
9
TO USE - SELECT POINT A AT SAME ELEVATION AS C
MEASURE VERTICAL ANGLES O AND O'
SCALE DISTANCES O AND b FROM MAP
LAY OFF O AND b ON SCALE AND READ a AND O'
a - O' = C
ON SCALE DIRECTLY ABOVE C READ b; THE DESIRED LENGTH OF THE UNSEEN AREA
SOLUTION OF RIGHT TRIANGLE
b = a COT. A
ON THIS SCALE a IN FEET IS SHOWN AT A DISTANCE FROM THE ZERO LINE EQUAL TO b IN MILES.
MASK
UNSEEN
I
II
III
A
B
C
O
O'
a
b
E

Elevation—unseen space scale developed on Upper Michigan. This scale was actually compiled for all angles up to 5°, but field trials proved most angles to be less than 2°, and nearly all hills less than 500 feet.



Sketch and map illustrating use of the elevation—unseen space scale as an aid to the angle-of-site method.

The angle-of-site method is designed to accomplish by mathematical means the work which profile plotting does graphically. In so doing it proves to be far more adaptable, since:

1. It can be used where no contour maps are available; the observer calculates his own relative elevations.
2. It is unaffected by the mechanical difficulties of plotting 10-and 20-minute angles, and for this reason is entirely workable in flat country.
3. When used with a detailed type and base map it takes into consideration *all* masks whether topography, timber, or buildings.
4. It is a mechanical method, it is easily taught, and consistent even when used by relatively inexperienced mappers.

AN EFFORT TO MAKE AERIAL SCOUTING SOMETHING BESIDES AN EMOTIONAL ESCAPE FOR THE EXECUTIVE

Clayton S. Crocker

Fire Control, Region 1, U. S. Forest Service

Some 3 or 4 years ago I heard someone remark that one of the stumbling blocks in the quick organization of suppression forces was the lack of detailed scouting information. This has been true on all the fires I have known.

In attempts to speed up and to perfect scouting, we have spent much time and money, but still our scout maps and data reach the dispatcher and organizer far too late to be of most value. Usually the data obtained is inaccurate and incomplete. Something better is needed, and here's what has been done lately.

We have six office men in Missoula trained to take pictures, develop the negatives, and make prints while in an airplane over a fire. We have developed a home-made kit for doing this work and have converted an old 5 by 7 Graflex into a foolproof scout camera. The whole outfit weighs about 75 pounds.

Experiments show that inexperienced men on their first trip in the air can take, develop, print, and drop the pictures in 18 minutes. Some have done it in much less time than this.

While we haven't had a chance to try this out on a real fire, I am confident it will prove valuable. Advantages are as follows:

1. Our scout plane and a photographer can reach most fires in the region and put pictures into the hands of firemen, rangers, and supervisors before the local ground scout could hike around the fire.
2. Pictures tell a story in detail not possible to obtain from maps and notes. They eliminate chances for discrepancies inherent in any attempt to correctly visualize conditions described through the eyes of another person.
3. Pictures give the fire boss or the dispatcher up-to-date information. The ground scout can't.
4. Series of pictures taken periodically will provide data for rate of spread studies, and should be worth while for study by Board of Review.

Some prints made by trainees are enclosed.[1] These are the first attempted and in most instances were taken too high above ground. However, it will give an idea of the quality of picture obtained.

The plan is to take a series as follows:

1. From a distance to define location, major topography, etc.
2. Close enough to get the entire fire or sector. This to give details of size, perimeter, and intensity of burning.
3. Very close to show details of fuel, ground cover, etc.

If the thing is worth it, I shall be glad to write it up in detail for other regions. It has taken 3 years to get this to a stage where we could say it is feasible and simple.

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[1] The prints are interesting, but since two of them show no actual fires and all of them would suffer greatly by transfer to a printed page, they are not reproduced herein.—Ed.

HOSE SCRUBBING MACHINE

K. G. Sedgwick
Project Superintendent
and
K. M. Macdonald
Fire Assistant, Nicolet National Forest, Region 9, U. S. Forest Service

Faced with the necessity of washing 6 miles of dirty hose after one of last summer's fires, members of the Nicolet personnel cast about for a quick, cheap way to clean the hose. The result was that Ken Sedgwick designed and constructed a machine to do the work. A patent, to be dedicated to the public, has been applied for.

During a period of 2 days of continuous operation (16 hours) the machine washed 26,600 feet of hose, with a crew of five men operating the machine and handling the hose. The crew consisted of a man to feed the hose in, one to draw it through, one to wash the ends near the couplings, and another to operate the machine. If the machine were to operate continuously, one or two extra men might be needed to carry the hose to the machine and unroll it.

The five-man crew was made up of FF men, paid at an hourly rate of $0.25. Labor cost figures came to $0.075 per hundred feet of hose. Average speed of the hose through the machine was 27.7 feet per minute, including time lost in placing the hose in the machine and removing it. Actual speed of the hose through the machine was approximately 40 feet per minute.

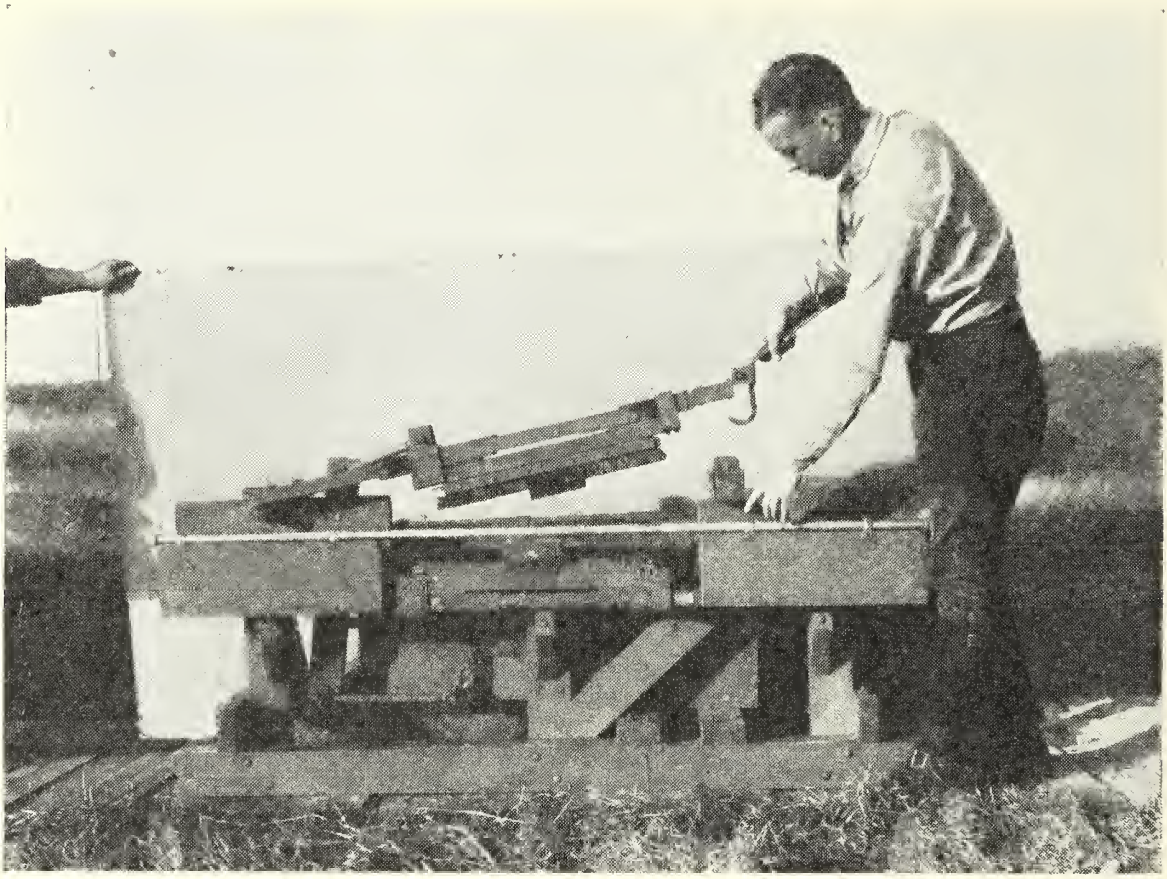
The costs for washing hose in this way are considerably lower, it is believed, than they would be if hose were washed by hand, although check figures on hand scrubbing time and cost are not available. The results are better than those obtained by hand scrubbing. The machine does not seem to damage the hose in the scrubbing process, although it tends to accentuate the folded edge which results from rolling the hose, but not appreciably more than hand scrubbing does.

In operation, the hose is rolled up at the fire and brought in to the ranger station, where the machine is placed at the lower end of the hose drying rack. The hose is then run through the machine and drawn directly up on to the rack, where it is allowed to dry. It is then rerolled and stored.

The machine itself consists of a wood frame on which are mounted two sliding brush carriers, one above the other, each carrying two regular floor scrubbing brushes placed end to end. The lower carrier has the brushes on its top side, with the bristles extending upward. The upper carrier has its brushes on the bottom, bristles down. The hose is drawn by hand between the brushes, while the carriers are driven in an endwise reciprocating motion by a small gasoline engine. The stroke of the brushes is 2 inches, and the speed is 300 complete (forth and back) strokes per minute. The two brush carriers move in opposite directions.

Before going between the brushes the hose passes through a trough 19 inches long in which it is thoroughly wet by water spraying from holes in a ½-inch pipe. The spraying is continued as the hose goes through the brushes and then through another trough where it is rinsed off before leaving the machine. On the Nicolet, water for the spray is supplied by a garden hose connected to the ranger station water system.

The upper brush carrier is so arranged that it may be raised while the machine is in operation, thus allowing the hose to be threaded through the machine without stopping the engine. The carrier is then clamped down and the hose drawn through by hand. The machine will not wash the hose right up to the couplings at the ends, so that in operation a man with a pail of water and a scrubbing brush washes by hand about 1 foot of hose next to the couplings.



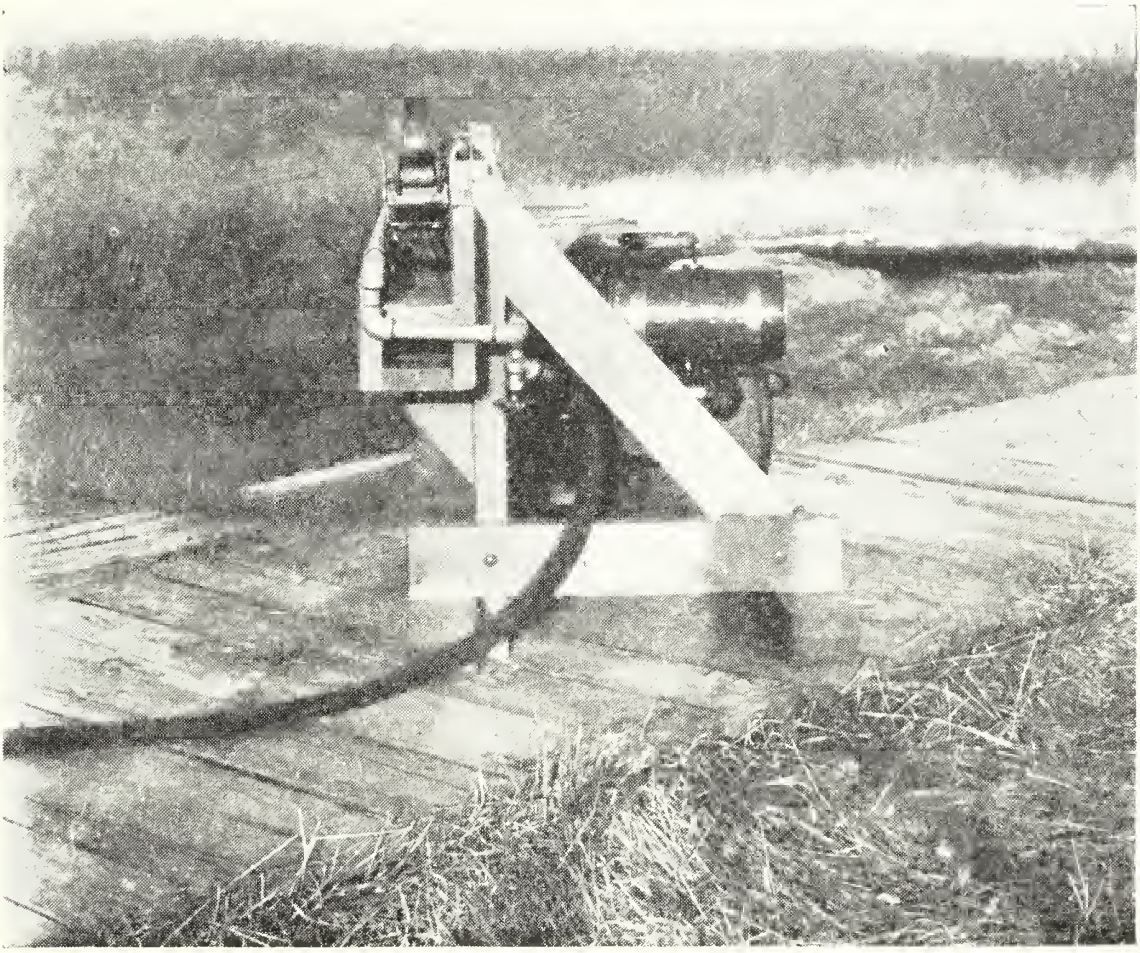
Front view of hose-scrubbing machine. Inventor holding the upper brush and pointing to places where hose is inserted.

In some cases the edges of the flat linen hose were not properly washed, so a pair of small vegetable brushes were mounted on the sides of the carriers, with their bristles extending horizontally inward. These remedied the trouble, but as the bristles were soft and wore out very quickly, brushes with stiffer bristles have been ordered. A set of regular scrubbing brushes is worn out in about 2 days of operation. They are easily renewed, however, as they are held in place with wood screws.

Motive power is supplied by a 1 horsepower 1,750 revolutions per minute Lawson single-cylinder gas engine, taken from a Forest Service portable power grinder. Power is transmitted to a crankshaft by means of a grooved pulley and V-belt. A connecting rod runs horizontally from the crankshaft to the lower end of a vertical wooden lever which is pivoted at a point about one-third its length from the top. A link from the top of this lever and another from a point two-thirds of the distance from the top connect with the brush carriers and transform the oscillatory motion of the lever into a reciprocating motion of the carriers.

The machine is 5 feet 5 inches long, 1 foot 11½ inches wide, and 2 feet high. Its weight is 282 pounds, including the motor, which is mounted directly on the frame.

The frame of the machine is made of 4 by 4 and 2 by 4 white pine, securely bolted together. The troughs, lever, and carriers are of 1⅛-inch yellow birch. No nails were used in its construction. All metal work was done by a Forest Service blacksmith. The crankshaft is carried in a pair of ball bearings from a tractor transmission. A sheet metal shield is installed between the brush carriers and the motor to protect the motor from water.



View of right end of hose-scrubbing machine, showing locking clamp in raised position, hose connection and piping, motor, splash guard, brushes, and trough.

It is estimated that this machine can be built for approximately $160, exclusive of the engine which supplies the power, although the designers' original model cost somewhat more. Power for the machine can be supplied from any available source.

A Simple Hose Reel.—Mr. Godden has developed an ingenious hose reel for winding hose to take it in after the fire is out or to move it to a new location. Very simply made from half-inch pipe, the reel is very portable and can be operated by one man. When the hose is reeled up tight, one side can be slipped off after the hose is tied, and the hose is easily removed.—From the article "Ready for the 1939 Fire Season," in the May 1939 issue of the West Coast Lumberman, which carries a picture of the hose reel.

LESSONS FROM LARGER FIRES OF 1938

Roy Headley

Division of Fire Control, U. S. Forest Service, Washington, D. C.

The July number of Fire Control Notes included an article on larger fires on the national forests. "Lessons learned" from these fires were quoted from reports when they seemed interesting and suggestive. Quotations from reports on 1938 fires are continued in this issue. The fact that a "lesson" is quoted does not necessarily mean that the editors agree with the conclusions. Experience of individual men on individual fires should contribute to the body of knowledge and ideas shared by all who may have to manage large fires. Whether this particular method is the best way of making "lessons learned" available to all, is doubtful. Criticisms and suggestions are invited. Would you get more from full case histories and complete comments on a few larger fires? Or do you get more from these brief pointed statements of what men have learned from many specific situations? Remember that we are now limited to four 40-page issues of Fire Control Notes per year.

California Region—Continued

Trinity—Glennison Fire—370 acres.—This fire reached the size it did as a direct result of crowning through the unburned canopy on the day following control. Past records will show that this is a common occurrence on fires in the Canyon Creek areas, and a special effort had been made to mop up the entire fire before the burning period of the day following control.

In spite of the efforts of 65 men with backpack pumps and a power pumper, the fire flared up from inside and crowned out in the unburned canopy of live oak.

If there is any lesson to be learned from this experience, I believe it is the necessity of having enough men with water equipment to cover the entire fire before the beginning of the next burning period. This is a rather difficult and costly procedure, especially when control is not achieved before daylight. The flare up on this fire began at 12 noon, which did not allow much time to cover the entire fire. Also, it is not advisable to send men into the burn before it has had time to cool sufficiently to allow them to work safely.

Control of this fire the day following was achieved by following the above procedure to a large extent. However, weather conditions were more favorable until the late afternoon, which allowed more time to mop up.

In summarizing the above, perhaps the most important point is to achieve control as early as possible the first night so that the fire will cool down before daylight, and allow more time for mop up.

Trinity—Little Bear Wallow Fire—2,200 acres.—C. C. C. enrollees are ineffective on a fire when not thoroughly trained in fire suppression, and they must be accustomed to hard hiking in rugged country and able to do effective work after arriving at the fire. In the case of this fire, the initial attack was made by an experienced guard and two green enrollees. The boys, who were transferred here with a New York company a day or so previously, were soft, untrained, and not accustomed to hiking, and not only slowed down the guard's travel time to the fire, but were useless after arriving there.

Pack stock was badly needed in the early stages of this fire. The absence of pack stock prevented the setting up of a dry fire camp to which food and water would have to be packed. Such a camp would have eliminated a long hard hike by fire fighters to and from the fire line.

The district dispatcher should be furnished adequate help both in the office and in the warehouse during a large going fire. He should not work over 20 hours on one shift.

Adequately trained men should be available to keep accurate records of all overhead and manpower on the fire line, or in the fire camps, and also to handle time slips and commissary supplies.

North Pacific Region

Siskiyou—Cedar Camp (*Chetco*) *Fire—34,627 acres.*—Something must be done to stop incendiary fires from being started to keep large fires burning. On the division in which I worked, it is a positive fact that one fire was set, and I am relatively sure that others were set in the same area. By way of a solution, the use of C. C. C. would probably be first, but in this case the C. C. C. was not available in sufficient numbers. Another solution, I believe, would be to use no crew not thoroughly supervised, even if it means using less men. For supervision, I believe that every straw boss unit should be led by a known straw boss. This would probably mean assigning many short term employees from other forests in cases of large fires.

Take the local man's advice as to fire behavior and wind drafts if he is reliable.

Reliable local men are indispensable as scouts, especially in unfamiliar country.

All trails should be brought up to at least secondary standards.

More roads are needed in inaccessible areas.

Division bosses should travel more on saddle horses than on foot, to prevent fatigue.

After the first few days, do not work the men more than 10 hours, as little is accomplished after that period.

Two weeks of hard fire fighting is about all the crews or overhead can stand. They should be relieved for a rest period if possible.

Discharge camp agitators immediately.

Provide comfortable and clean camps for the men. Better output of work will result.

Food for the camps should not be ordered from an itemized list as this clutters up the air for a long period of time when the channels should be free for other fire business. Order by the standard ration list.

Select dependable men for night patrol. Many hours of hard work are often lost through incompetent night patrol.

Adequate commissary should be provided the men, especially tobacco and socks.

Make a written record of all orders given and keep carbon copies.

Pack trains were more dependable than airplane service in smoky weather.

Airplane servicing proved itself on this fire especially where camps had to be located where no trails existed. Food and supplies could be furnished immediately or ahead of the men.

The importance of radio communication cannot be overstressed. It played a vital part in the control of this fire. The ultra-high S sets were indispensable to the scouting units. Their compact size and the ease of operation make them a very practical aid in fire fighting.

As a presuppression measure, I feel that in the future when a lightning storm is reported near the district during critical fire weather, that at least a 25-man crew should be held in stand-by for immediate attack. Due to a policy of not hiring local men for fire fighting, much time is lost in obtaining outside help.

On the actual suppression of the fire, the following defects were noted: The service of supply was not able to keep up with the number of men placed on the fire line. The men were worked too many hours per day for efficient work. Some of the fire line was not burned out soon enough, resulting in loss of line. More efficient bosses were needed on the line to keep the men working. Many of the men hired were physically unfit or not properly clothed for fire fighting. Greater care should be taken in the hiring of the men. These comments are offered not in criticism but for guidance in the future. In general, as compared to other project fires which I have been on, I feel that this one was handled exceptionally well.

Siskiyou—Nome Fire—5,800 acres.—Planes proved to be an excellent means of supplying fire camps both from the standpoint of speed and economy. Camps were serviced that otherwise would have had to be supplied by man pack, as was done for several days when planes were grounded, which required 8 hours of hard packing by good men to get 40 pounds of supplies into camp.

Planes will not eliminate the use of horses. During the time that this fire was burning the smoke became so dense the planes were grounded for several days, which clearly brought out the fact that pack stock must be relied upon at times.

Training given short term employees paid big dividends. The experience brought out the fact that we have a thoroughly competent, industrious, and efficient short term organization. It is believed that more could and should be done to give these men longer employment.

The lack of enough dependable foremen was in evidence. It is believed that more short term employees from other forests should be assigned for foremen and straw boss jobs on large fires, particularly in this area. (Both sides of this gamble must be considered. Sometimes the district loaning men has suffered.—Ed.)

Because of lack of trails in the area in which this fire burned, it was impossible to get enough men in to the fire in time to keep it from becoming a conflagration. At one time it was necessary to shift a camp 2 miles airline distance. Because of lack of trails and the rough country, it was necessary to hike the men 18 miles and truck them 6 miles.

It is useless to send men unless they are accompanied by a competent foreman in the proportion of not less than 1 foreman to 25 men. Practically all the errors on this fire can be traced definitely to lack of competent foremen overhead.

More use should be made of the indirect method of control on fires of this size and in this type of topography. There is always the human aversion to burned area that is continually cropping up on fires of this kind. Men work too close to the fire, thus sacrificing time and labor.

More satisfactory results can be obtained by dropping back and taking advantage of natural breaks in topography.

A stream, unless it is large and clear of brush, makes a poor fire line. The variable winds up and down streams, the possibility of rolling logs and falling snags, and the rapid spread of a fire up the slope once it crosses a stream, makes it exceedingly dangerous to use.

Siskiyou—Old Diggins Fire—4,207 acres.—On back country fires, the available pack stock for supplying crews must be given consideration hand in hand with the calculation of probabilities and the ordering of men to meet this calculation. Very difficult situations arise because of inability to supply crews on the line.

Strength-of-force plans for the district should be revised so as to include more intensive control during periods of bad fire weather and low visibility. This pertains particularly to areas where incendiarism is recurrent.

There is a need for a lighter, more compact backfiring tool to be included in our smaller fire fighting units.

For areas where incendiarism is a problem, funds should be available for hiring small crews for work on roads and trails, so that they will be available and close at hand for suppression.

Siskiyou—Siskiyou Fork Fire—1,396 acres.—The fatigue factor from walking long distances through brush and over rough ground must be considered in predicting output when men reach the fire. Such men on the initial attack will not do the work per hour fresh men or those transported to a fire will do.

Observations made from the air are often misleading, as it is difficult to tell accurately the actual conditions or resistances to control encountered on the fire line.

Siuslaw—Smith River Fire—27,500 acres (mostly outside).—The necessity and practicability of camping fire crews on the job, even if water must be packed by man power, was emphasized.

In some cases the fire line was constructed on the fire slope of a ridge instead of the opposite slope, which resulted in a difficult job of burning out.

Fremont—Bonanza Fire—9,155 acres.—The large area and rapid spread of this fire was due entirely to the dense and continuous stand of "cheat grass" (*bromus tectorum*) with very little timber overstory. Consequently, the usual "forest" fire standards are not fully applicable. However, the following was learned about this particular country.

1. Must keep roads cleared as fire breaks.
2. Must construct additional cross roads.
3. Must make definite plans for suppression (outline prepared).
4. Overhead, in general, needs more "mop up" training.
5. C. C. C. enrollees must be shown "how" by fire foremen and straw bosses.
6. On very large fires it is better to use machinery for trench construction at the sacrifice of some acreage than to depend on hand work too close to the fires.

Investigation of the cause of break-over on August 26 showed that while a good trench and clean burn had been obtained on the extreme southeast corner of the fire, and mop up had been carried back of the line an adequate distance for ordinary circumstances, the crowning of a small green pine tree on a low ridge about 300 feet inside the line threw sparks into the thick cheat grass and juniper timber which quickly crowned and spread under the brisk breeze. Men working in the vicinity of the break took action almost immediately, but were unable to cope with the heat of the crowning junipers and did not have time to use the indirect method.

Olympic—Green Mountain Fire—1,500 acres.—The lookout covering this area was on a patrol trip to a supplementary point and did not discover the fire until 15 minutes after it had been reported by the operator. It is always possible that this 15 minutes might have saved the day; however, due to an east wind and the fact that 15 men were unable to hold the fire a few minutes later, this too is doubtful.

There is also the possibility that had the pumper been put into use immediately upon arrival of the first crew, that they might have been able to drown this fire.

Rogue River—Trail Fire—1,089 acres.—Each sector boss should have a competent scout who is an experienced fire fighter to assist in locating lines and scouting ahead and who is responsible to him only. Other scouts working for the fire boss work at large and are often of no value to the sector boss who needs information on the line.

Scouts should not be men who merely know how to map and hike, but should be the best fire fighters available—men who know fire behavior from experience and can realize dangerous situations.

The camp manager should be a man who not only knows clerical work, but a man who knows fire fighting and requirements on the fire lines. This man should be the next important man to the fire boss.

A property or tool man charged with the responsibility of checking tools in and out and supervising the reconditioning of tools should be assigned each fire camp.

Related to the above is a question as to whether men should carry their tools back from fires, leave them on the line, or release them to relief crews. I am of the opinion that hand tools should generally be carried out for the following reasons:

1. Allows better control to prevent loss and theft.
2. Enables reconditioning of tools and means better tools on line.
3. Not apt to have tools one place and men another.
4. Prevents mixing of tools owned by different agencies.

On this fire the C. C. C. carried their tools out and the locals did not, and some of the above points were well illustrated.

A "camp boss at large" over three fire camps and assisted by a camp boss at each fire camp proved to be a good idea. In this way there was good correlation of activities between the various camps All supplies were ordered through this man from the SOS unit.

Rocky Mountain Region

Roosevelt—Jenny Lind Fire—664 acres.—I believe the most important point to be noted is the great difficulty of insuring adequate initial action on a very aggressive fire in its initial stages. (Three miners, 100 feet away, saw fire and attacked it 5 minutes after it started. District ranger with one man arrived at fire 35 minutes after it started. But larger crews did not reach fire in time to prevent 39- to 54-mile wind from starting fire on its first run. Probably most important lesson to be learned is that on a forest not provided with regular detection and other facilities common western fire forests, a fire starting in slash in a gale of wind could be and was stopped at 664 acres.—Ed.)

Almost uniformly there was too much tendency to bury burning material along the fireline in such a way that it only prolonged the burning and the mop-up period. The correct use of dirt has been so much emphasized that there are few if any of the foremen ignorant of the undesirability of partially burying heavy material; but there seemed to be great difficulty in getting this particular fault corrected.

A common fault which was perhaps the most serious was that of inclosing ragged fire perimeter inside a line without taking any measures to clean burn. This needs to be given a great deal of emphasis on all forests.

Southwestern Region

Gila—Canyon Creek Fire—502 acres.—This fire was started by a new employee of Mr. Adams, who was reputed to be a very careful man with fire. This emphasizes the need for personal contact with the permittees and employees which the rangers do carry out on this forest. The Gila rangers make a concentrated effort to contact all permittees through the whitling medium which I feel is the best method for this class of case. (But good as "whitling" is, it can't be done with everyone whose tendency to be careful with fire needs strengthening. Often there is time for no more than a few words—but those words need to carry ideas which will stick like cockle burs. For the benefit of readers, who will suggest such ideas, phrases, slogans which will stick, for use in the quick contacts which are so often the only ones possible?—Ed.)

Gila—Lookout Ridge Fire—575 acres.—Class 6 burning conditions prevailed and were not recognized. The fuels were very dry and the wind was strong. The lesson learned here is that a fire danger station would have furnished a definite check on burning conditions, and this could then have been promptly followed by proper stgenrthening of the guard force to meet class 6 or emergency conditions. (This forest is now supplied with a fully equipped station. Danger stations and danger ratings are designed to avoid just this sort of failure to recognize changes in fire danger.—Ed.)

Poor line location due primarily to trying to hold fire to a minimum acreage with subsequent loss of excess acreage was an important factor. This is merely a matter of training in suppression. (Yes, but training in judgment, which is the most difficult and most backward field of training.—Ed.)

Gila—Iron Creek Fire—2,318 acres.—Here again class 6 burning conditions existed unrecognized.

Too much line was lost by working too close to the fire. (Understand that this fire and this weakness were used by the region for training by the case method.—Ed.)

Width of fire lines must be governed by (*a*) fuel on ground; (*b*) steepness of slope; (*c*) wind velocity. In the past, fire lines have been entirely too narrow for safety in handling backfiring in windy weather. (Importance of training in judgment again emphasized. More common error is to make fire lines wider than need be for backfiring.—Ed.)

Intermountain Region

Wasatch—Shepherd Creek Fire—960 acres.—Particularly significant is that the fire, carried by a high wind, spread over 700 acres within 2 hours after it started. It traveled so fast that the fire truck, plow unit, and men could not keep pace. Forty men were on the fire within 20 minutes after it started, and, with our fire truck which suppressed a mile of fire edge, and the plow unit that made over 3,000 feet of fire line, it was impossible to cope with the high rate of fire spread. (But the wind dropped and the fire died down, after which the crews had a chance and did not muff it. An important principle is that the front of a fast running fire is often untouchable. But a lull always comes. The job is to be sure to grab it for keeps during that first lull.—Ed.)

Eastern Region

George Washington—Panther Gap No. 2 Fire—478 acres.—Fires had previously occurred along this portion of the C. & O. Railroad track. Inspection in February 1938 showed that the right-of-way was in very poor condition. This was brought to the attention of the section foreman personally and to the division superintendent by mail. No follow-up inspection was made.

Action on this fire, which was on a mountainside and almost entirely visible from the road, indicates that the hard and fast rule of requiring the district ranger (fire boss) to remain on the fire line is not always satisfactory. By remaining on the road with the whole fire spread out before him and with an adequate messenger staff, it was possible for him to know more about what was actually going on and be able to take quicker action than he could have on the actual fire line. In my opinion, the definite rule that the fire boss must remain on the fire line, in many cases, results in failure of suppression forces to take prompt action at critical points due to the very inaccessibility of the fire boss by putting him up in the front line trenches when he should be in a position where he can control the actual movement of his forces, both combatant and reserve, on the basis of what is happening on all points rather than just the local hot sector where he happens to be at the time a decision must be made. (This poses a problem which calls for more attention, more critical experience, and more carefully recorded experience for the benefit of all. Here is the dilemma on those fires where there is any real choice as to the method the fire boss follows in this respect. If he goes on the line, he will get the feel of the job in a way which cannot possibly be done through others. He can therefore, act more intelligently on the particular fire, and will also increase his priceless fund of direct fire experience. But as Supervisor Howard brings out in the above quotation, he will lose some control of the work on the job as a whole. Some men who have managed fires from a base camp with the aid of scouts, messengers, and a map laid out in the dust, are enthusiastic in favor of that method. Others say that a competent fire boss makes plans and issues general instructions; that frequent decisions are likely to gum things up; and that the fire boss can work through messengers and scouts while moving around the fire, as well as from a central point. If it is a matter of skillful discrimination between fires which call for one or the other of the two methods, what criteria may be set up to enable a fire boss to judge quickly and accurately which method is best for a particular fire?—Ed.)

Southern Region

Conecuh—"Boss" Fire—496 acres.—The fire area was about 30 acres on arrival. This can only be reduced under the prevailing conditions, by closer placement of suppression equipment. Maximum travel distance now 10 miles. To halve this distance would quadruple the number of fire crews. Question: How much can we afford to spend to reduce area on arrival? Certainly 30 acres is too large. (Since this fire only burned 64 acres within the protection boundary, it did not come within the definition of fires of over 300 acres; but it is included here because it raised in the minds of forest executives a question of such fundamental importance to socially-minded management of fire control.—Ed.)

Conecuh—"Big Fire"—576 acres.—In the attack on this fire, as in most other fires on the Conecuh, (wire-grass type of ground cover), everything depended upon the success or failure of the tank truck. From the time of attack with this truck until the water supply was exhausted (15 minutes) 19 chains of line were built. A reorganization has been made to provide for replenishment of the supply of water for the tank truck.

The fact that the first crew boss on the fire did not assume the role of fire boss contributed to confusion and loss of acreage. Intensive training in the duties of a fire boss is being given all crew bosses.

A whirlwind picked up burning material from as far as 100 yards inside the line and dropped it outside in the rough, resulting immediately in a break-over of large proportions. On at least two occasions whirlwinds hit the fire line while suppression was being carried on with tank trucks, resulting in loss of short lengths of line and excessive use of water. Variability of wind direction and prevalence of whirlwinds are factors not ordinarily considered in danger rating.

Evidence indicates there was time to have cut a line and backfired across the head. This would have speeded up control and promised better chance of holding to a smaller acreage.

Conecuh—Long Fire—442 acres.—The more basic problem, the elimination of the grazing fire as an element of risk, is, of course, being attacked from the educational angle, and some progress has been made in convincing stockman of the advantages of rough woods. However, the problem is intimately tied up with the regulation of grazing on the forests and warrants much study as well as administrative attention. The risk of stockmen's fires will likely be present on the Conecuh for some years. (The 1938 record on the Conecuh is so much better than for previous years as to suggest that progress has indeed been made on this outstanding problem of the grazing fire.—Ed.)

Conecuh—Bradley Fire—792 acres.—The education of local residents has not yet reached the point where they can be depended upon to follow all accepted principles in respect to debris burning. In this case, a line was plowed around a field and the fire set to burn into the wind. But the rancher failed to realize the high danger involved when burning at 10:30 a. m. Had this burning been deferred until late in the afternoon, there is no doubt but what the fire could have easily been confined to the field being burned.

It must be admitted that we do not yet have on the Conecuh equipment capable of stopping a large fire under severe burning conditions. Since the occurrence of this fire, our tank trucks have been improved somewhat by the use of a larger nozzle opening. This increases water consumption, but permits attack on a somewhat hotter fire. On later fires the use of two tank trucks abreast has been tried with some success. There is also a possibility of delivering more water from one truck by the use of two hoses.

There is a definite need for a mobile tractor-plow suppression unit, capable of rapidly plowing a line from which backfiring could be done. This type of equipment appears to offer the only practicable means for stopping the head of the occasional bad fire short of natural breaks.

The relative humidity on the day of the fire (December 3) did not reach a point that could be called low. This shows that relative humidity, in itself, cannot be relied upon as an indicator of fire danger.

Ocala—Pleasant Flat Fire—2,161 acres.—Our means of transporting men and equipment in the conventional type truck is unsatisfactory for the sandy roads on the Ocala. We plan to overcome this obstacle by replacing our conventional fire trucks with four-wheel drive trucks as rapidly as funds become available.

The ground of the timber type through which this fire burned is generally covered with water during periods of normal weather, but dries out several times a year so that it becomes inflammable. Since it is not very accessible by tank trucks, the construction of permanent meandering 8-foot firebreaks on the higher ground within the type will prove very helpful in suppression of any future fires which may occur.

This fire was also the first on which we used the new Mathis or Columbia two-disk plow equipped with a rolling colter. This equipment proved very effective, and with minor changes will become an important piece of suppression equipment.

Summarizing, I would say that the most important thing this fire showed was the inability of the ranger to make efficient use of the manpower and equipment that was available at the time of the fire. The matters of new and better equipment are secondary. (The ranger may take comfort from the fact that many others, including big shots in fire control, suffer from the same inability—but this should not deter him from seeking to be mentally prepared for efficient management of the next fire.—Ed.)

Choctawhatchee—Sandy Mountain Fire—2,381 acres.—The equipment we were using was in poor, worn-out condition and failed on the fire line. This has since been corrected by a new tank truck which has been built and equipped with a power take-off and centrifugal-type pump.

Burning the boundary biannually is not sufficient to cope with the control problem of exterior fires. To remedy this we plan to burn a strip having a minimum width of 300 feet around the north and east boundaries each year; this will give us a 300-foot strip freshly burned adjacent to a 300-foot strip with a 1-year rough, and it is felt that this will form an adequate base from which a backfire can be set.

The fire-training meeting that followed this fire indicated that our previous method of handling fire-training meetings was not reaching its objective. The most effective means of discussing strategy in fire control we found to be the drawing of an actual fire on the blackboard by one member of the group, picturing the fire as it was when he arrived. He wrote on the board all of the actual conditions, that is, men and equipment that he had, size of fire, condition of fuel, direction and velocity of wind, time of day, land status, etc. In other words, I wanted to eliminate from the very start the pet answer, "it all depends." Each member had an opportunity to describe or to lead a discussion on one or more fires that he had been on in the past several years. After placing all the information on the board portraying the ire as it was when he arrived, he would then ask different members of the group what they would do under like conditions. After the fire had been thoroughly discussed, the leader of the group would then tell them what he did and what the results were.

I felt that this was probably one of the most effective fire-training meetings I had ever attended because every member was eager to describe his experiences and to criticize the action that had been taken on the other fires by other persons, and the opinion of the group after the meeting seemed to indicate that they had all gotten quite a bit out of the meeting.

Kisatchie—Big Fire—650 acres.—It takes considerable training and actual fire fighting to get C. C. C. crews up to the output of 6 chains per man-hour which was attained on this fire. To insure such an output for the future, all C. C. C. members of companies used for fire suppression must be put through an intensive 3-day fire school at east four times a year. The rapid turn-over of enrollees makes the quarterly fire school absolutely necessary. If enrollees are properly trained and well led, 6 chains per man-hour can be maintained without any undue trouble. (More power to Supervisor Bryan, the author of these brave words. The weighted average output per man-hour on the 25 larger fires in region 8 in 1938 was 1.67 chains.—Ed.)

This was a man-caused fire set for grazing purposes. It probably was not the intention of the trespassers to burn Government land. However, the fact that it did burn Government land did not worry them very much as it was just additional burn for their stock to graze upon. Fires originating outside of our fire and national-forest boundaries are, as a rule, more dangerous than those arising inside. The reason for this is simply that they are farther from the centrally ocated source of manpower, and by the time a crew reaches them they are so large that control is exceedingly difficult. The Kitsatchie Forest had five 300-acre and larger burns during the 1938 season. Three of these fires originated from so-called grazing sets which occurred outside of the national-forest boundary. When one considers that 90 percent of the land immediately outside of our boundaries burns at least annually, it is not surprising that some of these ires will cross the boundary and burn national-forest land. State ire laws are not enforced, and the area outside has no protection except that afforded by its proximity to national-forest land.

It is the opinion of this forest that the outside fires will never be completely solved until the outside area is placed under protection. The grazing of cattle, horses, sheep, and goats conflicts directly with ire control. Regardless of who owns the land, stockmen, as a general rule, are going to burn in the spring if they think they can get away with it. We can, in a measure, stop them from burning outside by fire-prevention talks, law enforcement when the fires set endanger Government land, and general educational programs. However, the real solution for outside fires is protection for that area.

This forest in the past spent most of its time and money on fire prevention within the boundaries. The number of fires within the boundaries have been steadily decreasing, and it is now our problem to stop the setting of those fires around our boundary which could possibly creep over to Government land. This is a large job, as our boundaries are long and a large number of people live just outside. It will take several years to make much headway, and the problem will never be settled until this outside land is put under adequate protection from fire.

Kisatchie—Honey Fire—1,092 acres.—In this case the fault lies with the fire boss in his failure to recognize extreme fire conditions that existed on January 25, and to modify his attack to fit these extreme conditions. If he had realized, or had had means other than his general knowledge and experience to guide him in selecting the correct method of attack, the fire would have been controlled much easier, and with a somewhat smaller acreage. Instead of attempting a direct attack, had he backfired all existing roads and firebreaks facing the oncoming fire, the fire would have been controlled at about 700 acres and the slash-pine plantation inside of the fence would have been saved. The amount of held line per man-hour would have been at least tripled. One answer is a well-constructed fire-danger meter which will leave as little as possible to the judgment of the fire boss on the fire line.

The only method of controlling this fire at a smaller acreage after it had started would have been an immediate attack by the indirect method of backfiring. Under such conditions, tank trucks and specialized equipment are of very little value. A strip of burned ground at least 400 feet wide is necessary to stop the heads of such a fire.

The fire was started by the L. & A. Railroad train which was temporarily stalled at the point of origin. The Louisiana State law requires that the railroad free their right-of-way from combustible material. The forest has never been able to force the L. & A. to do this. The railroad officials have been warned, both in person and by letter, many times. Also, they have paid suppression cost and damages for other fires caused by their railroad. Railroad business is rather poor, and the officials took the attitude that they could not afford to keep rights-of-way clear as required by law. Reimbursement for damages and suppression costs amounting to $2,160.62 has been asked for.

Since this fire occurred, however, the railroad officials have decided it is cheaper to clear the right-of-way than to pay damage and suppression costs. Both the L. & A. Railroad and Missouri-Pacific Railroad Cos. have cleared their rights-of-way of combustible material within the forest boundary. For the first time in the history of the Kisatchie Forest, we will enter the 1938-39 fire season without the constant hazard of railroad fires.

Fusees used for backfiring in some of the tool boxes had absorbed enough moisture from the air to be worthless. The wet or damp fusees could not be detected by casual examination. Some delay in backfiring was caused by these dud fusees. Fusees cost only about 9 cents a piece, and this failure could have been eliminated by simply replacing old fusees with new ones every 30 days.

Kisatchie—Slash fire—407 acres.—Two hundred and ten acres of the fire had only recently been planted to slash pine. The slash pine of course was totally destroyed. The rough was composed of wire grass, broomsedge, and a fairly heavy carpet of hardwood leaves. The rough was of 5 years' accumulation, and can be considered heavy for longleaf type.

Investigation revealed that the fire was handled very well by the lookout men and the dispatcher. The discovery, report, and get-away times are excellent. However, the decision of the superintendent to send only 6 men with the junior foreman in a pickup to check on the fire was sadly at fault. The day was not an extremely bad one; however, a fresh south wind was blowing and any fire located within a quarter or a half mile south of the boundary certainly should have merited both the fire truck (tank truck and Panama pump) and a full 16-man crew with the standard fire-fighting tool box. If the junior foreman had had a full 16-man crew and fire truck he would have unquestionably held the fire with only an acre or so of national-forest land burned.

Kisatchie—Cactus Fire—488 acres.—The C. C. C. enrollees from the State camp had only been at Fullerton Side Camp about 10 days at the time of the fire. They had been transferred there to assist in the heavy planting program. These men were absolutely inexperienced in fire fighting and, consequently, had only what training could be given them in this time. It is little wonder that they became panic-stricken on a fire such as this, not having had the chance to gain the experience necessary on fires of lesser severity.

The seat of this lies in the decision of Superintendent Warner to keep his men separate from the enrollees of the home company. This was a wise decision from the standpoint of supervision of the men on the planting job, but left a woefully weak point in the fire-fighting organization.

When it is necessary to augment our regular camps with additional men for a heavy planting program during the fire season, there will be a split of men in such a way that we will be assured of a good sprinkling of well-trained men in every crew. This will be an addition to an intensive training program for all new men.

Kisatchie—Boom Fire—877 acres.—This was an incendiary fire and was the result of four separate sets. These fires were not set by local residents. The area is grazed heavily only in the spring and early summer when cattle are driven out of the swamps by the backwater of the Mississippi River. Many of the stockowners who graze their cattle on the forest at that time live and normally graze 30 or 40 miles away. These men are not interested in growing trees, but are solely interested in good grazing for their stock. They firmly believe that a fresh burn is much better than a rough at that time of the year, and many of them will resort to nearly any measure to get the burn desired. Better law enforcement is one of the answers. Control of grazing by fencing and issuing permits is another. Fire-prevention contacts with stockmen will also help. Next winter the forest plans to have at least one man roaming this area on foot or horseback for the sole purpose of apprehending at least one trespasser. One conviction on a criminal charge of wilfully setting fire will unquestionably do more real prevention work than anything else.

DeSoto—Saucier Fire—635 acres.—The weather conditions made the hazard extreme. There had been no rain for 3 days. The relative humidity was 33 at noon. Wind velocity varied from 8 to 16 miles per hour during the fire. The ground cover was broomsedge grass. The flames had a range of 40 to 60 feet, crowning at times and spotting ahead.

Instructions were to backfire from a fire lane on the west side. This firebreak had been constructed 2 years ago and had not been maintained since this time. As a result, it was grown over and offered no effective barrier from which to backfire. The extreme weather conditions made it improbable that even if the firebreak had been recently maintained, the crew would have been able to hold their backfire on this narrow line.

DeSoto—Hell Hole Creek Fire—509 acres.—This fire emphasized how immediate and continued work on the flanks of a large fire can keep the acreage to a minimum and prevent new heads from forming when the wind shifts. Crews worked the flanks continually so that when the head was finally stopped the entire fire was corralled within a very few minutes.

The head of this fire presented a wall of flames 20 feet high, with a range of 30 to 40 feet. It was burning in a 5-year rough. Several of the fire fighters had narrow escapes while attempting to stop the head. Two different pump men were forced to abandon their pumps in order to outrun the fire.

This fire, as well as other large ones on the DeSoto, shows that in extreme weather conditions a great deal depends on the dispatcher's judgment in placing crews, not only for the head but for work on the flanks. The speed at which these fires travel offers little opportunity to correct tactical mistakes on the fire line.

North Central Region

Chippewa—Lundeen Fire—370 acres.—Training plans must be flexible enough to provide for abnormal years. Training plans called for the training of the dispatcher and lookout men prior to our normal fire season, but as the spring fires started 25 days prior to our normal season the dispatcher and lookout men were inadequately trained. It is believed that this fire would not have reached this size had the men been given more thorough training. The area when reached was estimated at 60 acres.

Areas of this type should be burned over in the spring when conditions are safe and snow is present on the high land, as areas of this type are used for pasture by local settlers. If not burned, they will be set by the local settlers when weather conditions are favorable for burning.

The action by the suppression forces was satisfactory, with the exception that a scout should have been used to reconnoiter the fire and secure any clews or evidence as to the individual or individuals responsible for setting the fires.

Gardner—Tower Fire—489 acres.—This was one of a series of 25 fires burning on the district on this date. The fire danger was class 6 and the wind velocity was 20 miles per hour. The fire spread rapidly in highly inflammable leaf and grass fuel. Topography was rugged with steep slopes, which accelerated the rate of spread. Winds shifted frequently and small whirlwinds occurred along the fire front. As a result the fire had a number of heads, with one traveling along the top of each main ridge. The fire advanced in a solid sheet of flame, leaping 6 feet high in most places, and the men could not get near the fire because of the intense heat. Spot fires, jumping in many cases over 100 feet ahead of the main fire, were common. There was 2 to 3 years accumulation of leaves on the area.

When Assistant Ranger Barry arrived, he took charge of the fire immediately. He made a quick size-up of the situation, determined that direct attack was ineffective (It had already failed.—Ed.), and directed the crews to drop back several hundred feet from the fire edge to construct line. The technique used, which consisted of raking a line and backfiring from it, was considered satisfactory under the circumstances. This dropping back was essential because whirlwind conditions caused fires to spot 100 to 200 feet ahead of the main fire.

Knowing the conditions as are known now, fire management could have been improved by backfiring from the truck trail and keeping the fire from crossing it. However, the use of this technique would have required at least 25 additional men as there were separate heads traveling toward the road.

The district personnel feel that bloodhounds could be effectively used in tracking down trespassers; merely the knowledge that bloodhounds were being used for this purpose would make the local residents less apt to set wild fires. When this matter was taken up with the regional office however, the use of bloodhounds was opposed for several reasons, the principle being that bloodhounds are usually associated with running down murderers, kidnappers, and other criminals in that category, and should not be used as a deterrent medium for reduction of man-caused fires. (But after years of fairly successful use of bloodhounds in a small way, the southern region feels that the use of dogs for this purpose should be greatly enlarged.—Ed.)

The general belief that all fires in Missouri hardwoods can be handled by direct or parallel methods is false. On certain days, conditions are such that the only practical method is to drop back to natural or cultural barriers, such as the road in this case, and sacrifice some burned acreage in order to insure control.

A more extensive use of water should be resorted to on such days. On this fire three men could not control a 5-foot spot fire by use of rakes. A marine pump would have saved the first line built on this fire.

Gardner—Flat Fire—302 acres.—This was the only fire burning at the time, and most of the enrollees were in camp and available. Therefore, in view of the available manpower, wind velocity, darkness, and possibility of multiple sets, the dispatcher was justified in sending 31 men instead of the usual smaller initial attack crew. It is our policy to send more men to night fires during hazardous periods, since experience has shown that travel time is slower and held line production is usually very low.

Gardner—Brookshire Fire—412 acres.—As a result of our experience on this fire, an organization of fireguards and suppression squads paid from P. & M., F. C., and F. F. was set up at strategic points to supplement C. C. C. during critical days.

The held line constructed per man-hour on this fire was three chains. During periods of class 6 danger, with a wind of 20 miles per hour, held line construction is necessarily slow because of the need for a wide line and careful patrol immediately behind the crew to keep the burning leaves from spreading across.

This fire was set and tended by local residents. They were intent only on burning their own land and claimed to be unaware that any Government land was inside their fence. A contact with Mr. Brookshire warning him before the fire was started might have prevented it. However, he was taken before a justice court and pleaded guilty. This action should have a very desirable effect in the locality for fire prevention.

Gardner—Thurman Junction Fire—412 acres.—The slopes on most of the burned area were between 40 and 50 percent, and in some cases much steeper. A strong wind prevailed, as was evidenced by a large number of tree tops broken during the time the fire was burning. At least 60 different places were set afire along the bottom of a deep dry ravine for about 1¼ miles. The fire spread rapidly up both slopes. The change in tactics used by the person setting this fire is of extreme importance in this locality. Previously, sets have been made by following the ridges. In this case, sets were made in the bottom of a deep hollow in the most blind place possible. As to prevention, controlled grazing with definite allotments would probably have eliminated this fire.

Superior—Sand Creek Fire—329 acres.—Most of the line was made with a tractor and plow. Need was emphasized for a foreman with good judgment to direct the furrowing crew in line construction. This is necessary to shorten the amount of line by cutting across burning points, and burning out, especially where low timber values are involved. (Why use up a foreman on line location at which he may or may not be expert? Why not train a cat-skinner to locate his own line, or when that is not practicable, have him directed by a man who, while not a foreman, is skilled and trained in the art of line location?—Ed.) This point was very outstanding on the fire as the furrowed line followed the fire and no burning out had been done, hence a sinuous line of great length and loss of line in the northeast corner due to lack of burning out directly behind the plow unit.

Crew foremen need more training in burning out to the furrowed or trenched line. This fault was very pronounced on the south half of the fire. The foreman would not burn out and I had to do the job myself in order to get it done. Also, the foremen did not stay with their crews, directing their work, but left them with leaders and assistant leaders in charge. This fault possibly results from lack of knowledge of the ability of individual foremen and rating them too high on the fire roster.

I noticed a great deal of wasted human effort through the lack of training or knowledge in what constitutes a fire hazard. When large living aspen is cut down close to the fire line as a hazard, I believe more training is necessary to correct this error in judgment.

Extract from a Board of Review Report—Name of region, forest, and fire withheld.—This fire became large primarily because of ineffectual control work by green, slip-shod C. C. C. crews used in initial attack. Subsequent losses of line appeared to be due chiefly to reburns caused by failure to burn the moss from trees. The story is well covered in the Forest Board of Review write-up and accompanying conclusions for this fire.

The use of trail builders in building a truck trail into the fire allowed the largest construction job on a fire yet undertaken to be completed rapidly and when needed. Radio was also advantageously used.

The weaknesses that showed up are enumerated below as a checklist for action to avoid repetition in future:

1. Water supply for men on top of ridge was not made available until close to the end of the campaign.
2. There was lack of knowledge of the situation at various times on the part of directing heads. Also failure to calculate size of job and manpower needed.
3. Shortage of right tools at the right time and place.
4. Men were instructed to get tools from forces they were relieving, resulting in failure to contact and no tools for relief forces.
5. Moss on the trees was not burned off.
6. After fire was lost, men tried to fight too close for about 2 days.
7. Backfiring delayed; might easily have resulted in disaster.
8. Pessimistic outlook and manning for worst possible situation rather than existing.
9. Excessive manpower and overhead. Current manpower organization records were not maintained.
10. Weak line organization; high-caliber men in camp and not enough of this type on line.
11. Lack of prearrangements as to crews, trucks, and rations.
12. Insufficient and lack of proper handling of property; failure to check invoices of supplies resulted in considerable loss.
13. Wage rate and time-keeping difficulties, resulting in minor labor troubles. Standard crew-boss time records would have helped.
14. Records not adequate, not coordinated or properly checked, resulting in duplicate orders for men and equipment and supplies.
15. Off-shift men, especially overhead, did not go to bed when possible in many cases.
16. Lack of transportation from camp to line, etc.
17. Outside pack stock could have been ordered earlier.
18. Crews got lost. Adequate guide service needed.
19. Definite marking of station locations on the line and on a duplicator map would have prevented crews or bosses getting on wrong sectors.
20. Excessive costs on this fire. Records of charges to fire not kept currently so that reasonably accurate charges could be made. Arbitrary prorating of costs distorted picture of costs on this and the other fires.

(Aside from the foregoing the management of this fire was all right. But before you set this instance down as a horrible example of what could not happen in your territory, consider two questions: (1) Do you know, and have you faced what really happens on your own jobs, and (2) have your larger fires ever been subjected to the type of honest and searching forests and regional inquiry from which the foregoing resulted? Good management of larger fires is probably more exacting than any other management job except the direction of a battle in human warfare. Blunders, wastes, failures cannot be wholly eliminated. But they can be reduced. The analysis in this case has what it takes to do just that.—Ed.)

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FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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The value of this publication will be determined by what Forest Service officers, State forestry workers, and private operators contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire-fighting methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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THE BURNED-OVER AREA AS A CLASSROOM IN FIRE-CONTROL TRAINING

ALVA A. SIMPSON
Fire Control, Region 3, U. S. Forest Service

The control lines and the burned cover on a cold fire can be read almost like an open book by a fire-control veteran. But in such a post mortem he always wishes he also had before him a clear record of the significant movements of men, planning, good thinking, mistakes, confusions, and wastes that were a part of the action. If he had such records in addition to what he can read on the ground he would indeed have an open book to study. However, who wants to provide an open book for the benefit of an analyst or inspector? Isn't there a more fruitful use to be made of it? The author says there is and tells of what has already been done in the Southwestern Region.

The answer to the question, "Will training leave the trainee with
perience on which he can draw as a guide to proper action in the
b he is going to do?" intrigues all those who engage in training
rected at more effective methods of meeting administrative and
anagement problems on the national forests. Any training pro-
ram must be pointedly directed toward specific objectives. In fire
ntrol, training in fire prevention may be entirely different from
aining in preparedness or fire suppression.

In Region 3 an attempt has been made to train the permanent per-
nnel in attaining better and more effective suppression action
rough the use of an actual burned-over area for the classroom. As
s been frequently pointed out, the major losses in burned-over areas
d the greatest expenditures are caused by a relatively small num-
r of fires which fall into the classification of "extra period," or
ver-300-acre fires." Likewise, the proportion of such fires to the
tal number extinguished is so small in Region 3 that on an average
t to exceed one district ranger out of 25 will obtain actual experi-
ce in handling such a fire in any one year, or to express it in another
y, the average ranger will experience a large fire about once during
s period of service. Lessons learned even from experience are
mmed by the passage of time, and as an approach to a method for
eping knowledge more current in our minds, Region 3 has em-
rked on a training program by which the regular personnel respon-
le for fire control are given opportunity to see on the ground the
uation which existed and the action which was taken to control a
ven fire. This is followed by free and open discussion of the
ssons learned," using the conference method. The problems which
e fire presented are outlined in writing.

The classroom should ordinarily be of a size which will permit the
oup to see, within a 2- or 3-day period, including discussion time,
l of the topographic features, cover types, and other elements which
fluenced the behavior of the fire. The conference room may be a

point from which problems of the fire can be observed or some poin where a critical attack was made or strategy developed. The grou should include not more than 20 persons, a smaller number bein preferable. The leader must develop his program on the basis of th situation which is being studied. This means that an extra-perio fire may present problems which are different from a fire which ha been controlled within the first work period. Preparation of th curriculum on the ground, in advance of the actual group trainin and provision of a good map of the fire are the responsibilities of th leader. A wide range of subjects may be developed. Wind movement as influenced by topography, slope, aspect, and cover; the fir behavior in different fuel types or as influenced by topography; th presence or absence of natural barriers; transportation and communication; the manipulation of manpower and equipment to secure mos effective results; and many other factors will integrate themselve into a planned curriculum.

After the group has "sized up" the essentials of one or two of th problems presented on the fire which is being used as a classroom they are stopped for conference discussion. After discussion, th leader sums up briefly the various viewpoints and gives step by ste the action which appears to have been best for most effective contr practices. Following this, prepared problems are read to the grou and each member is requested within a specified time limit to wri his answers to the questions. The problem presented to one grou was:

This fire was discovered at 2:50 p. m. from – lookout, 4 miles distant.

Burning conditions:
Wind, 30 to 35 miles, from southwest.
Temperature 95°.
Humidity 3 p. m.—10.
Precipitation on 13 days between January 1 and June 15, with 0.47 in since March 28.

Available manpower and travel time from fire:

Lookout fireman, Hillsboro Lookout	1 hour.
2 emergency firemen, Sawyer Peak	1½ hour
Per diem guard and 20 men, Kingston	1½ hour
Per diem guard and 25 men, Hillsboro	1¾ hour
25 CCC, Mimbres side camp	1 hour.
25 men, Silver City	1½ hour
State road maintenance crew, 3 men	¼ hour.

100 additional men available at Silver City by 6 p. m.

Question: What would be your initial action with respect dispatching men and what would be the priority of dispatching?

Following this question a second problem was given as: "Fi spreads to 40 acres within 1 hour, and is 1½ miles long and ½ mi wide in 2 hours. How would you plan attack and what methods attack would you use? How many men would you order for follo up and how would you dispose of them? How many camps wou you establish and where?"

The questions were answered, of course, after a visit to the grou over which the fire burned had resulted in a very good size-up what should be done to achieve control in the first work period.

Space does not permit speculation as to the extent of the subje to which this type of training will apply. Results are measure

›wever, by the action of those who have been trained, and several ersons engaged in the control of rapidly spreading fires during the ‹treme burning conditions of June 1939 credit on-the-ground training for the control of these fires in the first work period.

In preparation for such training, camps or facilities for taking ıre of the group near the fire area are necessary. Usually the fire ımp can be occupied, giving an opportunity to examine critically ıe arrangement and facilities of the fire camp itself and to include the program training in service of supplies and camp management.

.939 aerial picture developed and printed in a plane while over a fire. See rticle on aerial scouting by Clayton S. Crocker in the October 1939 issue of 'ire Control Notes.

THE DRY-ICE TANKER TAKES TO WHEELS

A. B. Everts

Assistant State Project Director, Connecticut, New England Fores Emergency Project

The spectacular performance and unusual amount of publicity which has been given to this novel device have stirred up a great deal of interest in dry ice as a pressure medium in expelling water for fire fighting. Hundreds of questions have been asked and not satisfactorily answered. Here is the inventor's own description.

In 1644, a Dutch chemist, Belmont, recognized carbon dioxide a a distinct gas, differing from other gases in many ways. It wa not until 1922, however, that the first cake of dry ice (CO_2) wa produced commercially. The cost was prohibitive. Later variou processes of producing "the ice without water" were perfected, an dry ice began to find commercial uses.

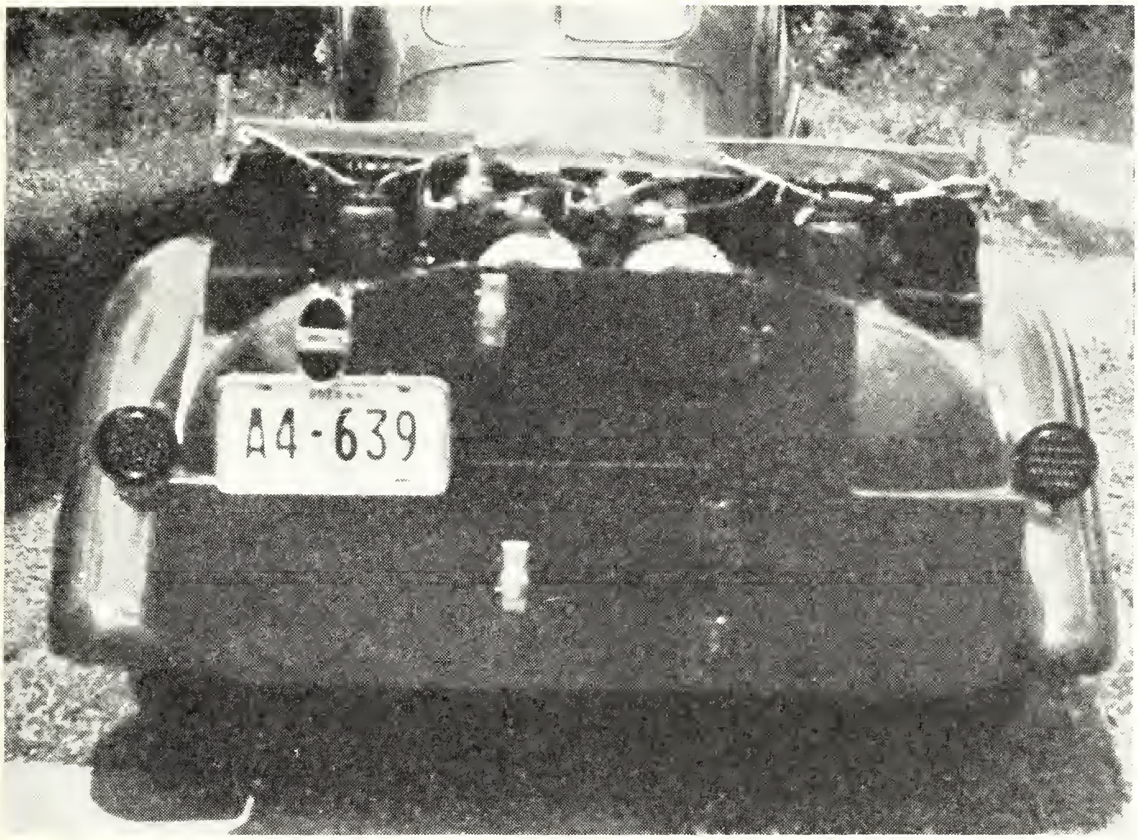
A few years ago an inquisitive chemist was intrigued by the vapor escaping from the mud volcanoes near the town of Niland in th Imperial Valley in southern California. Investigation proved tha the vapor was carbon dioxide, 99.6 percent pure. An oil-well ri was set up and drilling started. When the drill had been sunk 60 feet, a pocket of gas was struck, and sand, water, steam, and ga were hurled high in the air. From this initial experiment what i probably the largest field of nearly pure carbon dioxide in the worl has been developed. The price dropped from $150 to $35 a ton, an dry ice came into its own.

Meat packers use dry ice in refrigerating meat, manufacturers fo shipping ice cream, motion-picture producers for producing fog engineers use it as a pressure medium in riveting steel, miners fo blasting coal, mechanics for running motors. Others use it in way too numerous to mention.

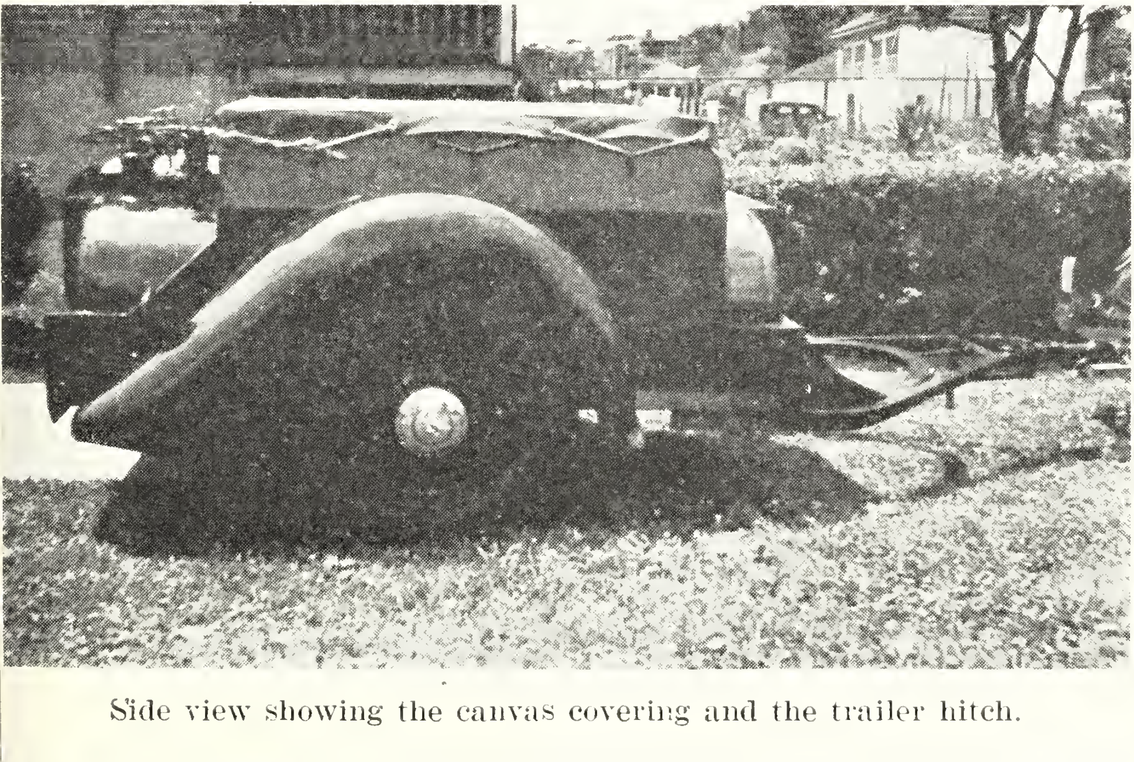
In 1937, while assigned to the Cleveland National Forest in southern California, the writer experimented with the use of dry ice confined in heavy steel cylinders, or convertors, as a pressure mediu for expelling water from a tank. From this first crude experimen conducted with a hot-water tank and a miscellaneous assortment fittings on the dock at San Diego, the first dry-ice pressure unit w evolved.

This unit consisted of a 50-gallon steel pressure tank mounted angle irons which could be inserted into the truck body of a ½-t pick-up truck. On top of the tank a live reel was mounted f carrying hose. Two dry-ice convertors, each with a capacity of pounds of dry ice, were used for producing the pressure.

The convertors weigh 70 pounds uncharged and have actual been tested at a pressure of 7,900 pounds to the square inch. Th are equipped with soft blow-out safety disks which rupture at 2,8 pounds pressure. The dry ice is inserted into an opening in the t of the convertor and the lid closed. When dry ice in confined, immediately creates a pressure against the lid which seals the co vertor. The rise in pressure is very rapid up to 75 pounds, at whi point the gas, as it sublimes from the solid, becomes a liquid. Wh all of the solid is melted, the convertor contains a liquid on t



nd view showing the storage compartment door and the arrangement of the convertors and control valves. The convertors can be recharged without being removed. The taillight is connected by a cable to the stop light on the towing car.



Side view showing the canvas covering and the trailer hitch.

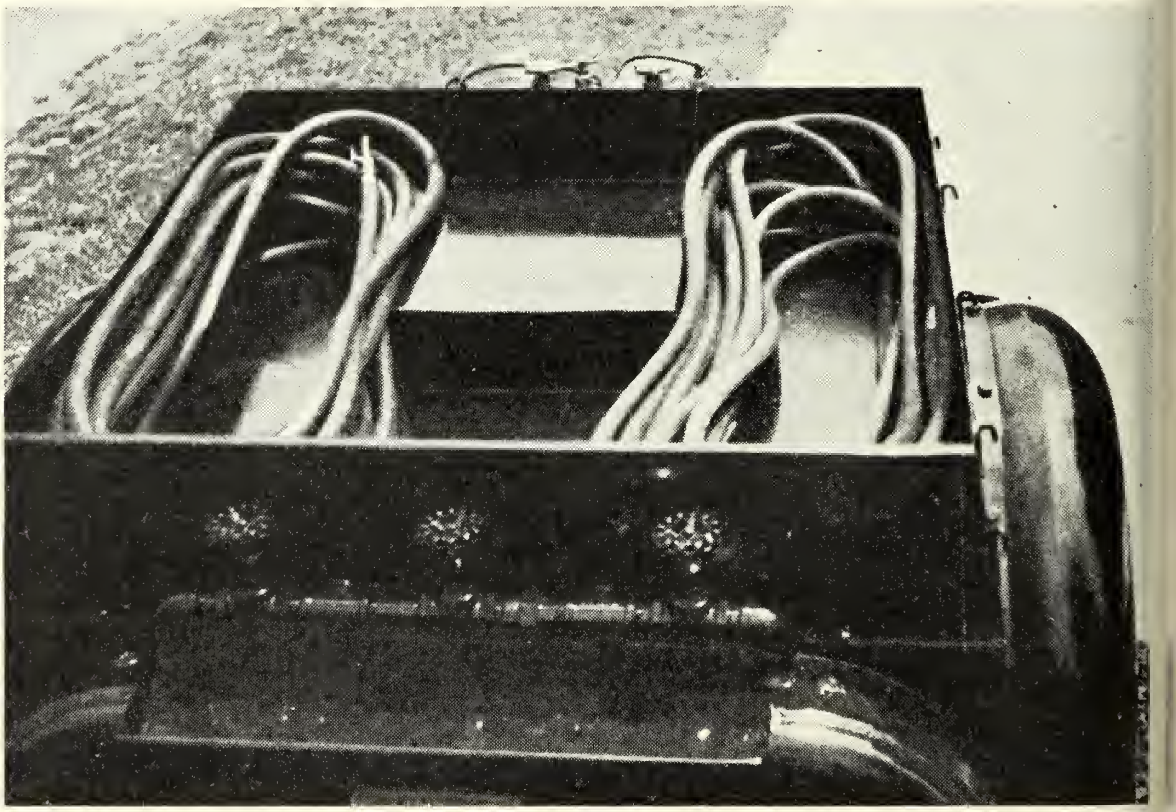
ttom and a gas on the top. At 77° temperature the pressure is 3 pounds per square inch. As gas is withdrawn from the top, ough liquid converts to gas to keep the pressure at 933 pounds til the last drop of liquid is gone.

This pressure is stepped down to the desired working pressure means of a reduction valve and is carried through a copper tube the pressure tank. This pressure then forces the water through the hose line. Tests made with the 50-gallon unit showed that the tank could be discharged from 7 to 10 times, depending on the temperature, pressure used, and size of nozzle opening.

In January 1939, the writer was transferred to the New England Forest emergency project with headquarters in Hartford, Conn Through the efforts of the State director and the encouragement of other officials from the Boston headquarters, funds were allotted to construct a new unit, this time on a larger scale.

Two 100-gallon tanks, each 6 feet long and 20 inches in diameter were mounted on a light-truck axle. Around these tanks a superstructure of steel was built so that the tanks are entirely enclosed on the inside. Access to space between the tanks is provided by steel doors both front (not illustrated) and rear. This space can be used for carrying hand tools such as axes, shovels, etc., or for additional hose.

On top of the tanks a solid hose basket has been provided. At the rear and at the bottom of the basket a pipe leads through a 1½-inch gate valve to the hydrant cap filler plug. Thus, under field conditions, the hose can be used as a funnel in refilling the tanks. Tiny holes in each corner of the basket drain off excess water when the tank is full. The unit can be easily filled from a stream or water hole with canvas buckets. If filled from a hose, the 2½-inch hydrant cap is removed. Drain plugs in the front end of the tanks permi easy draining. A canvas top is lashed down to hooks on the side of the hose basket when the unit is not in use. One-inch pressure release valves are set at 110 pounds pressure, thus insuring safety i too great pressures are used.



Top view showing hose basket and valve arrangement. Two streams of wate can be used simultaneously or the water from both tanks can be directe through either hose. Note the valve stems permitting the use of air in combination with or in place of CO_2.

he unit in operation. Six hundred gallons can be discharged before the convertors need recharging. At 100 pounds pressure each tank will operate for 10 minutes using a ¼-inch tip.

The valve arrangement on the front end of the tanks will permit wo hose lines to be used at once or all the water (200 gallons) may e directed through one line.

Valve stems have been brazed to the tanks in the front so that ither air or CO_2 or both can be used. However, if air alone is sed, space must be left in the tank because air, unlike CO_2, will not e absorbed in the water. In combination they work very well, the O_2 supplementing the air as the pressure goes down.

The CO_2 convertors lie on their sides, in a specially built comartment, with the valve outlets up. Thus the gas, and not the quid, is drawn off. Each convertor is provided with its own eduction valve. With this arrangement two independent units are rovided, and different liquids or chemicals can be expelled at the me time, as is necessary if foams are to be produced.

The unit can be hauled behind any car equipped with a ball-andocket trailer hitch. A stand is provided for use when the trailer detached.

Empty, but with two fully-charged convertors, the unit weighs 145 pounds. The additional weight of 200 gallons of water will ring the total to 3,805 pounds. This is about 200 to 400 pounds ore than a loaded two-horse trailer. The use of lighter steel in e construction of the superstructure would easily lighten the weight y 500 pounds or more. The writer recently investigated a copperloy tank made of Everdur metal. These tanks withstand 300 unds pressure and are lighter than steel tanks. They should be st what is desired for the use of chemicals. A 75-gallon tank costs 9. Two such 75-gallon tanks would handle well behind a pick-up passenger car.

The cost of the unit as constructed in Hartford was approximately $550 complete with hose anl fittings. Of this cost $300 was for the tanks, the steel, and welding alone. On an order of a dozen or more units the cost should not run over $400. Dry ice costs from 2½ to 6 cents a pound. Dry Ice Incorporated, Nu Ice, and several of the liquid carbonic companies are the biggest agents. Many ice-cream manufacturers and dairies offer it for sale. It can be shipped anywhere in the United States in 24 hours. There is, however, some shrinkage in transit.

In tests, we found that we could expel three 100-gallon tanks before the convertors were discharged. Tests were run at 100 pounds pressure, using a ¼-inch nozzle. It took just 10 minutes to discharge the tank. In the last 100 gallons there was a dropping off in pressure toward the end, but the effect upon the length of the stream was very little. I am inclined to believe that this occurred because of freezing in the minute opening of the reduction valve. Water was discharged for 50 feet throughout the test.

With this unit, control is automatic at the nozzle. That is, gas will flow into the tank at whatever pressure the gage is set until the pressure is equalized. If the nozzle is then opened and water is expelled, more gas will flow into the tank.

In conclusion, it must be stated that dry-ice units can never take the place of large-capacity tank trucks, or even small ones, where a large volume of water is needed. However, working on the theory that all fires are small when they start and considering that 8 or 10 of these units can be built for the cost of one-medium-sized tank truck, they would seem to have their place. With no pumps, no motors, no moving parts, they are simplicity itself. For estate and grain field protection, for speedy patrol in connection with logging operations, and for spraying various chemicals and liquids, their possibilities are beyond question.

The Ruidoso Training Session.—Sixteen rangers from 11 national forests o the Southwestern region gathered at the Bonnell ranch on the Ruidoso River Lincoln National Forest, the afternoon of October 9. The next 2 days were spent on the Cedar Creek fire area, where a fire, endangering the residentia section along the Ruidoso, occurred on June 15, presumably from hot ashes deposited on the forest floor.

The fire crowned within 100 feet of point of origin in a 20–40 year age stand and developed into a spotting fire which presented intricate problems to tes the resourcefulness of the fire boss and his organization. Specific problems in camp layout, organization, and suppression technique were given to the rangers from strategic viewpoints where the area could be studied to advantage. With the written answers received, the proper action to take was fully presented by the instructor with ample opportunity for discussion on the ground.

A demonstration of backfiring technique with a supposed fire approaching saddle was given by three of the rangers, showing the method of using buffer lines in bringing the crown fire to the ground. Backfiring will continue to be used and with increased confidence after viewing such a demonstration.

The final morning was spent in a study of the erosion-control work on th area. Contour strips had been planted to millet, brome, and grama gras seed. The planting was too late to permit maturing, although the millet wa 6 to 8 inches in height. Eighty poles or logs per acre had been felled an placed on contours above trees or stumps in order to retard run-off and to hel build up deltas to serve as seedbeds for vegetation.—Alva A. Simpson, fir control, Region 3.

CONSISTENT PLOTTING OF ADDITIONAL COVERAGE

Karl E. Moessner

unior Forester, Superior National Forest, Region 9, U. S. Forest Service

Detection planners in relatively flat or gently rolling country have always been plagued by the difficulty of determining how much seen area would be added by different elevations to be obtained by towers. The author offers a mathematical solution.

The erection of a portable tower exceeding 60 feet in height is
kely to prove a difficult job. In addition, the cost of using such a
wer on a detection survey involving a large number of points would
nquestionably be prohibitive. For these reasons, seen-area maps
f unoccupied points in flat country are seldom made from a height
qual to the tower which would actually be erected should the point
rove acceptable.

Although fair results can be obtained by studying seen-area maps
ade from towers of varying heights, the detection planner is fre-
uently asked to estimate the coverage possible from a tower higher
an the one used by the field mapper. This additional coverage is
pecially important where the planner advocates:

1. The shift of an existing tower.
2. The use of an exceptionally tall (120-foot) tower.
3. The erection of a taller tower at a point already occupied.

Since these estimates may be the basis for spending a considerable
m of money, they should be conservatively dependable. Assump-
ons based on personal opinion will seldom be within the required
andard of accuracy.

Eliminating the expensive remapping of the point from a higher
wer or taking a chance and erecting a new tower without prior
oof of its value, the planner is faced with the necessity of calculat-
g mathematically the additional seen area.

A technique recently developed on Upper Michigan National
orest is offered as a consistent method of making this estimation
added coverage. The basis for this method is a mathematical
lculation of the new length of each unseen area, along rays from
e tower through each prominent mask. These rays are originally
otted by the field mapper, who records on the map the vertical
gle to each mask as measured by his instrument.

The calculation is made on four known factors and can be summed
in the simple formula on page 11.

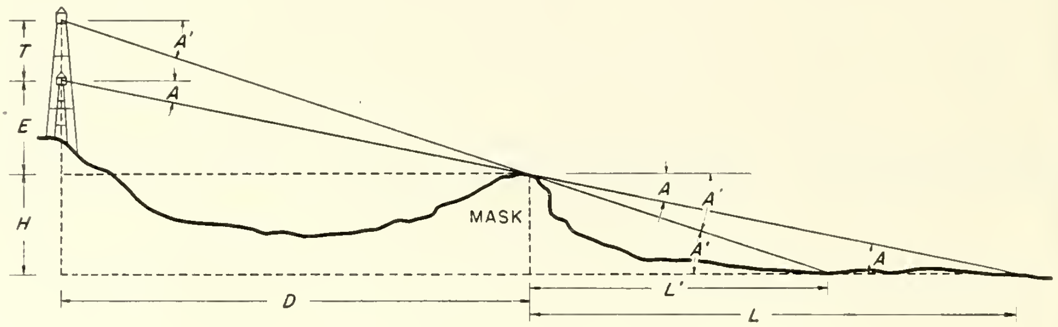


Figure 1.

I. In the diagram:

A=the verticle angle, tower to mask, measured by the field mapper an recorded on his map.

D=the horizontal distance, tower to mask, as sketched on the fiel map.

L=the length of the unseen area as sketched on the field map.

T=the difference in height between the present or mappers' tower, an the one to be used at this point.

II. We can calculate by trigonometry:

A'=the verticle angle of the mask from the proposed tower.

H=the height of the mask above the extremity of the unseen area.

E=the elevation difference between the mask and the top of th original tower.

III. We wish to determine:

L'=the new length of the unseen area.

Substituting in the right triangle formula:

$$a=\frac{b}{\cot A}$$

$$E=\frac{D}{\cot A}$$

$$H=\frac{L}{\cot A}$$

And substituting in formula:

$$\cot A=\frac{b}{a}$$

$$\cot A'=\frac{D}{E+T}$$

And substituting in formula:

$$b=\cot A$$

$$L'=H\cdot\cot A'.$$

To reduce this formula to known factors, we substitute and get:

$$L'=\frac{L}{\cot A}\times\frac{D}{E+T}=$$

$$L'=\frac{LD}{\cot A(E+T)}$$

Again substituting, we get:

$$L'=\frac{LD}{\cot A\left(\frac{D}{\cot A}+T\right)}$$

And clearing, we get:

$$L'=\frac{LD}{T+D\cdot\cot A}.$$

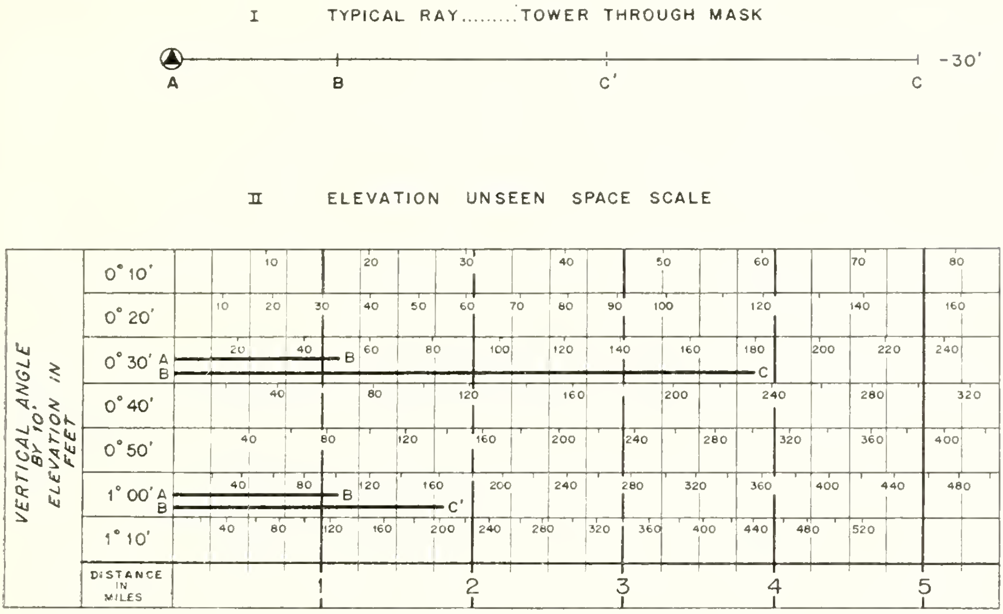


Figure 2.

indicates a typical ray as shown on a seen-area map. A is the tower; B, the mask; and C, the far edge of the blind area. The figure 30' at point C is the minus vertical angle measured from the tower. C' is the new edge of the unseen area. II indicates the space scale readings used in this problem.

$$L' = \frac{LD}{D + T \cdot \text{Cot } A}$$

this formula:

L = the length of the unseen area in feet as measured from the original field map.

D = the distance in feet from the tower to the mask as plotted on the original field map.

ot. A = the cotangent of the vertical angle, tower to mask, as recorded on the field map.

T = the difference in height of the old and the proposed towers in feet.

L' = the new length of the unseen area.

The derivation and proof of this formula is given in figure 1.

While the computation by formula is relatively easy it requires e use of trigonometry tables which may not be available, and pre-pposes a working knowledge of trigonometry on the part of the anner. In addition, the calculations require some time.

For these reasons a simplified procedure has been worked out using e Elevation–Unseen-Space Scale,[1] which gives quick results of the quired accuracy. Figure 2 illustrates this method.

1. On the 30-foot scale lay-off *AB* (1.12 miles) and read 55 feet, e elevation difference of the present tower and the top of the mask.
2. On the 30-foot scale lay-off *BC* (3.84 miles) and read 180 feet, e elevation difference of the mask and the far edge of the unseen ea.

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[1] Described in an article "Seen-Area Mapping—A New Technique," Fire Control Notes, ober 1939, p. 18.

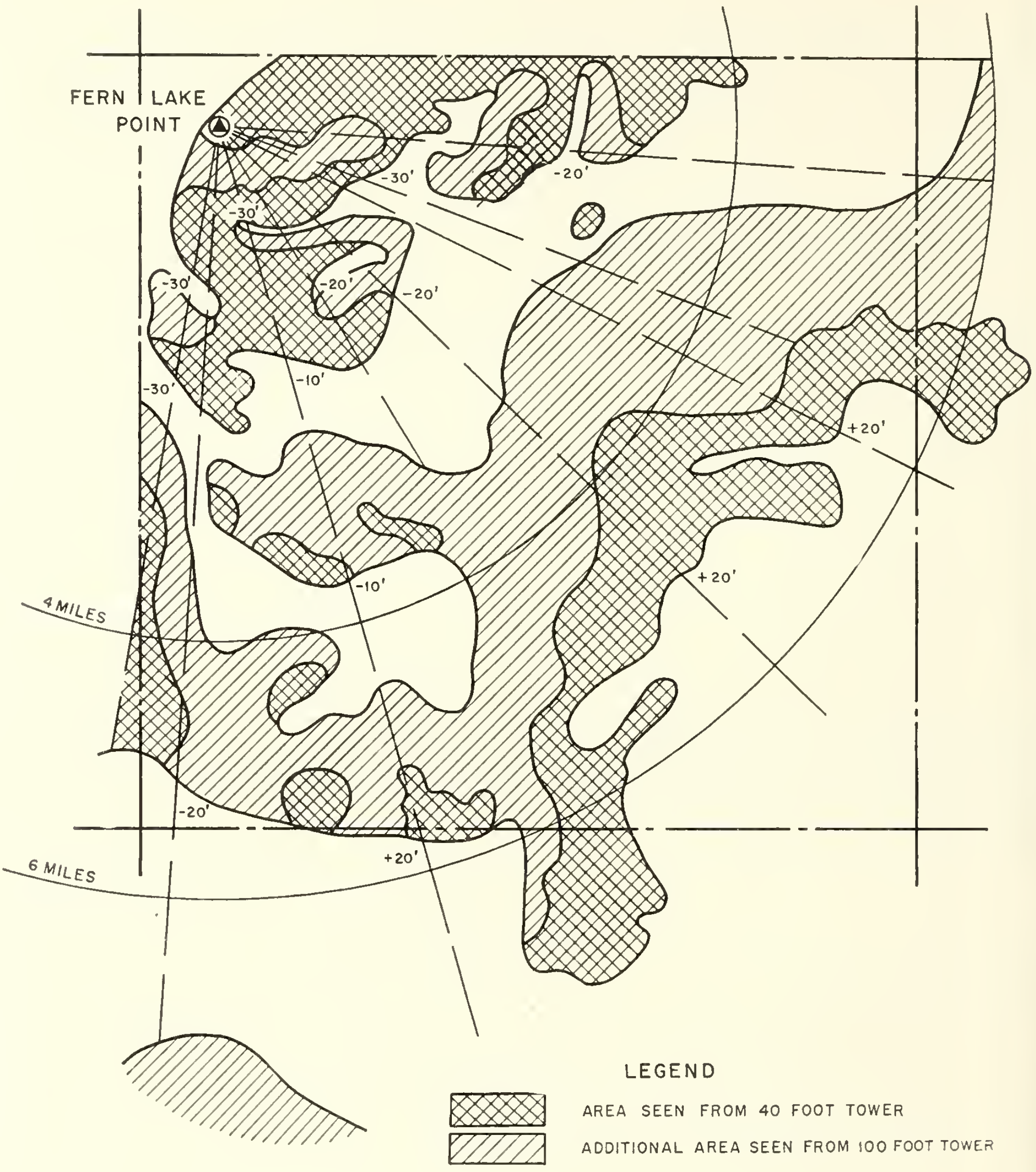


Figure 3.

The above sketch is part of a typical map made from a 40-foot temporary tow
with estimated 100-foot coverage as sketched by the elevation—unseen spa
scale.

3. Assuming that the present tower is 40 feet high and that t proposed one will be 100 feet, the elevation difference of the ne tower and the mask would be 55+60 or 115 feet.

4. Using distance *AB* and 115 feet, we find the new angle lies b-tween 1° and 1°10′ and interpolating, we assume it to be 1°5′.

5. Using 1°5′ and a figure of 180 feet (see step No. 2) we agai interpolate and read *BC′* (1.70 miles), the new length of the unse area.

Substituting into the formulas, derived in figure No. 1

$$L'=\frac{LD}{D+T\cdot\cot A}$$

s a check, we find

$$L'=\frac{20{,}460\times 5{,}940}{5{,}940+60\cdot 114.6}=\frac{20{,}460\times 5{,}940}{12{,}816}.$$

L′=95,040 feet.

L′=1.8 miles, an error of 0.1 miles, which on a number of rays will rove compensating and can therefore be ignored. After the new ength of the unseen area is figured and indicated on each ray the utline can be sketched in on the map by connecting the plotted oints.

Figure 3 shows the way a completed sector of the revised map ould appear.

In using this method the planner may find that the outer unseen reas extend indefinitely and he therefore has no way of calculating he height of the mask. In such occasions the only available method s to estimate the probable height of the mask. The error so incurred s not likely to be dangerous, since the relative accuracy of any seen-rea sketching drops decidedly beyond the 6-mile radius.

Prevent Forest Fires—It Pays.—What do we buy with our prevention expen-itures, and how can we evaluate it? Well, here are some data from the Mount aldy District of the Angeles for the Fourth of July holiday:

	Cars	People	Number	Percent	Cost
egistration	7,933	25,107			
ontacts other than by registrars		5,986		23.8	
iolations of fire and sanitation regulations			44	.59	
ersonnel:					
Registrars (per diem)			6		$120
CCC (man-days)			60		90
Patrolman			10		178
Supervision					20
Travel					50
Total					458

SUMMARY

otal cost	$458
otal people	25,107
ost per person (cents)	1.8

Weather conditions: Except for the first day conditions were normal. The re danger classes of organization indexes were as follows: July 1, class 5 first emergency); July 2, 3, and 4, class 4 (normal).

Results: There were no fires on the district during the holidays.

The field force reported that this crowd was very well behaved.

We do not claim any records of cost or any extra efficiency of personnel. hese data are given just to show the effectiveness of registration and patrol fire prevention. Since records for the Angeles from 1921 to 1938 show the verage cost for fire suppression for individual fires to be class A $431, class B ,403, and class C $35,900, we feel that the prevention costs were well worth-hile.—From the California Ranger, Wm. H. Maxwell, district ranger, Mount aldy District, Angeles National Forest.

THE USE OF SMALL TANKERS IN FIRE CONTROL

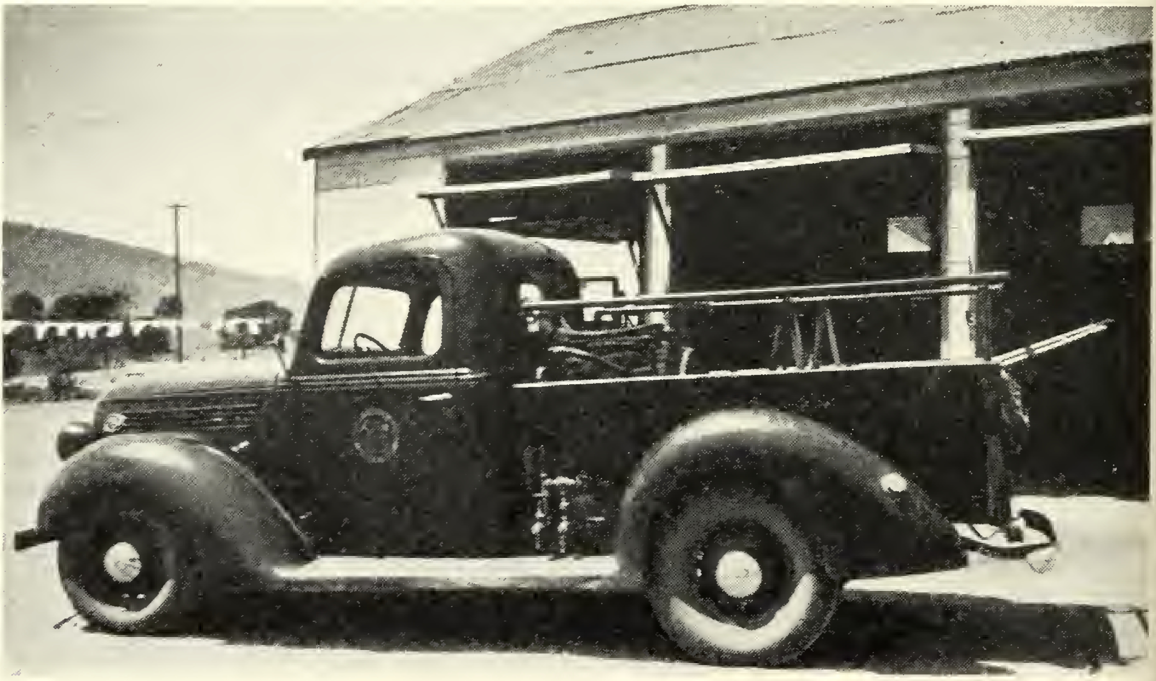
JAMES K. MACE
Ranger, California State Division of Forestry

The greatest number of fires that do the most damage are man-caused and are usually started near roads or in areas which are accessible to small pick-ups. When fires can be reached by these pick-ups, the quickest way to bring them under control is to use water.

Calaveras County is considered one of the "hot spots" in the Sierra Nevada Mountains. Although the topography is rough, there are many county roads, CCC truck trails, and old abandoned roads, and many of the ridges and valleys can be covered by small pick-ups.

Before the 1939 fire season, two administrative ½-ton pick-ups with four-speed transmission were converted into small tankers. They are capable of carrying 65 gallons of water and five men with the necessary fire tools. The pump used is a Panama, with a capacity of 15 gallons per minute at 100 pounds pressure; 100 feet of rubber-covered hose is used.

In use, the small tanker goes into operation on arrival whenever the fire is burning in grass, bear clover, pine needles, or short brush. As soon as the head of the fire is stopped, the small crew that accompanies the tanker or pick-up starts building trail and throwing back the hot spots left behind the tanker. If the fire cannot be stopped by direct attack, a backfire is started just ahead of the main fire, the pick-up being used to put out the backfire away from the main fire. The crew follows, making the trail safe.



The San Andreas ½-ton tanker.

Although the amount of water available for first attack is small,
r economical use, many fires are checked until the larger tankers
rive or until the arrival of additional suppression crews. In this
rticular area it is very important to stop the head as soon as possi-
e, and if this can be accomplished by the small tankers, it is a
latively easy job to tie up the rest of the fire.

When a fire reaches large proportions, again the pick-up is very
luable as it makes equipment available for the hot spots.

This type of equipment is much cheaper than the standard tanker,
nd it makes possible several units on a fire, which gives a better
hance for control than when only one or two of the large tankers
re available.

The administrative pick-up has been used as a small tanker in
is area only during the current fire season but its practicability
as been proved and the units have paid for themselves many times
ver in controlling fires.

Cooperation on the Coronado.—As an example of good work in [illegible]
plication of prevention pressure, we quote the following from the Coronado
er Diem Guard Bulletin. Patterning the effort to [illegible] group got
sults:

"Last spring a check-up on man-caused fires during a period of 5 years
dicated that 32.5 percent of such fires were caused by prospectors and miners.
his information came to the knowledge of Mr. Ed Bohlinger, prominent
gislator and mining man of Patagonia, Ariz. Mr. Bohlinger very kindly
fered his cooperation and saw to it that the Small Miners Association of
izona was duly informed of the facts. As a result, during the 1939 forest
e season to date, out of the 17 man-caused fires on the Coronado Forest, only
or 17.6 percent, were caused by prospectors and miners. Assistance such as
at rendered by Mr. Bohlinger and by the numerous miners and prospectors
th the national forest is of the highest type of cooperation in the war to
otect the nation's natural resources."

Why Stop Them?—What the residents of Van Buren, Mo., think of the value
fire prevention was answered last week in a leaflet entitled "Forest Fires—
hy Stop Them?" Sponsored by the Progressive Forum and the Conservation
deration of Van Buren, several well known citizens were asked to contribute
ort statements concerning the benefits resulting from keeping the fires out of
ssouri woodlands. Farmers, merchants, doctors, housewives, lawyers, and
ockmen, all residents of Carter County, responded with their statements which
re published in the leaflet.

Supervisor Kelleter said the leaflet was an index of the aroused and effective
erest on the part of residents in the vicinity of Van Buren.

Brodie White, a farmer living near Van Buren, said that preventing forest
es would result in "better water supply, more hog range, better timber, and
s erosion."

Brad Greene, another farmer, said, "Fires on my land do me more harm
n good."

This statement was made by Carl Hudson, Social Security director of Van
ren: "Had our forefathers dreamed that as they burned over our forests
ar after year they were creating unemployment conditions that would
ntually cause their grandchildren untold suffering, undoubtedly they would
ve desisted from the practice. Taking a lesson from them let's help our
ldren's children and stop burning the woods."

lark Forest officers were optimistic over the human interest angle used
in the fire-prevention campaign of the Van Buren citizens. There were com-
nts to the effect that the statements in the leaflet were made by local
izens, all long-time residents of the community. They would be read by
ers. It was said that other communities would follow the same approach
reach the local resident.—Daily Contact, Region 9.

USE OF OZALID PAPER FOR MAKING COMPOSITE SEEN-AREA MAPS

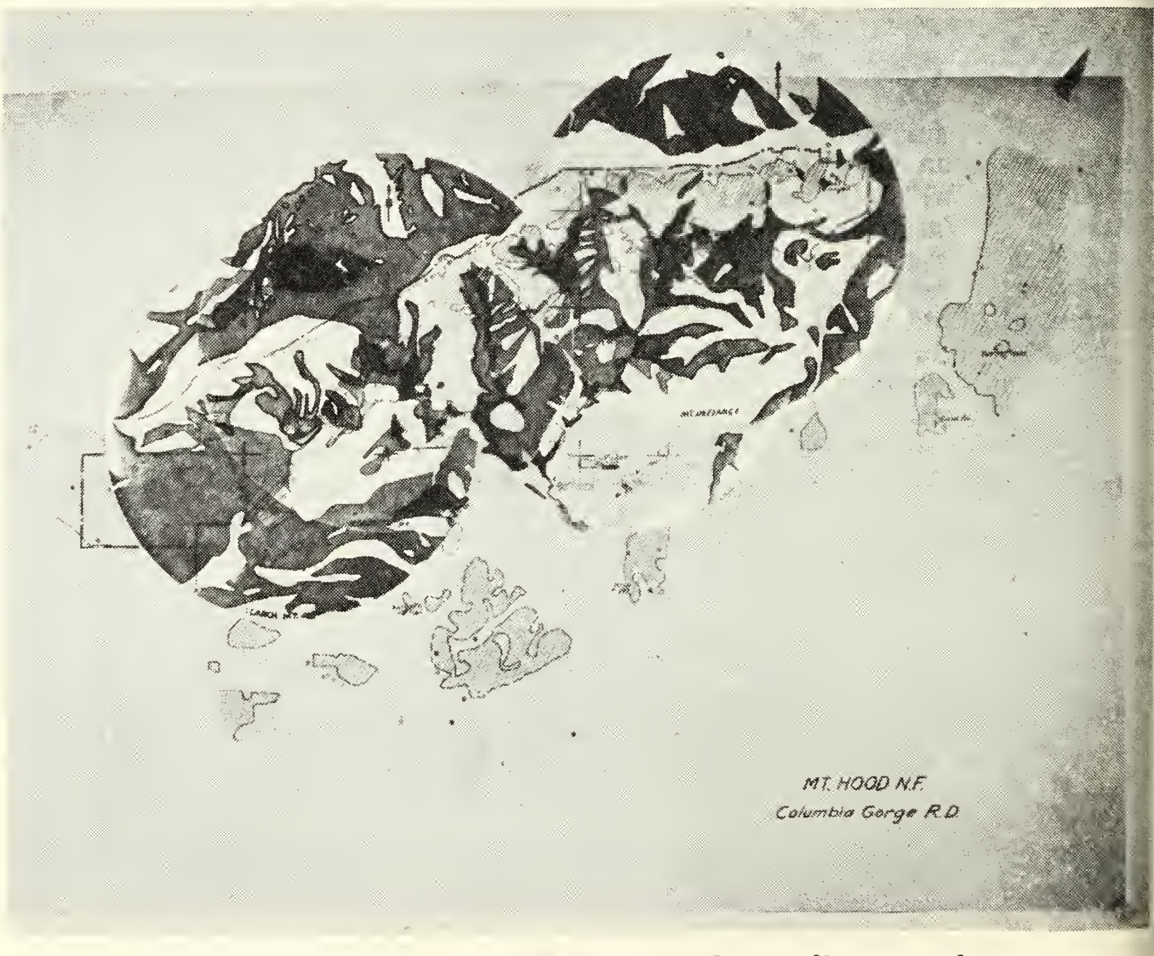
Vernon E. Hicks
Junior Forester, Region 6, U. S. Forest Service

In the preparation of a detection plan for an area, it is ofte desirable to make several composite seen-area maps showing coverag obtained by using differing combinations of lookouts. Preparing composite seen-area map by use of a vellum overlay and colore pencil is a time-consuming process, requiring 2 to 4 hours for ranger district. The use of Ozalid paper makes it possible to produce a comparable map in 15 to 20 minutes.

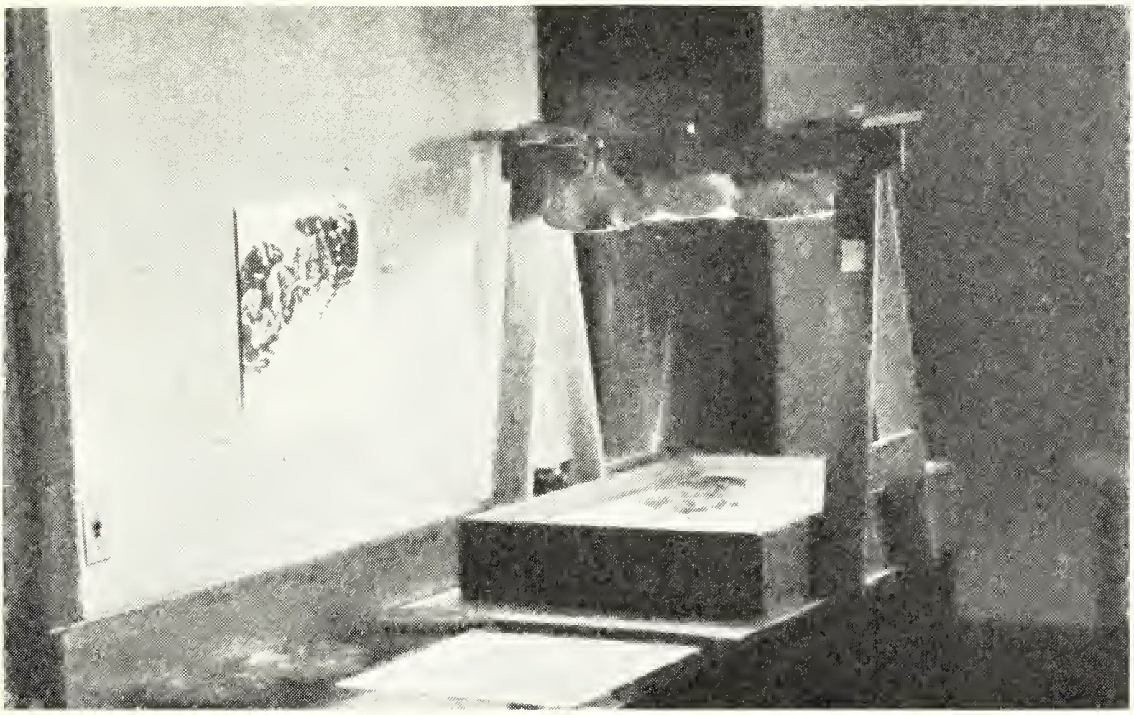
Ozalid paper is a sensitized paper having the following advantages

1. May be exposed by natural or artificial light.
2. Requires only ammonia fumes for developing.
3. Print is exactly the same size as original.
4. Paper is not sensitive enough to require the use of a dark roo and may be handled in the subdued light of any room into whic the sun does not shine directly.
5. Relatively inexpensive.
6. Cannot be over-developed.

In this region, visible-area disks have been prepared on Plastacel for 5-, 8-, and 15-mile radii for most present and potential lookou



Visible-area disks oriented and taped to vellum overlay.

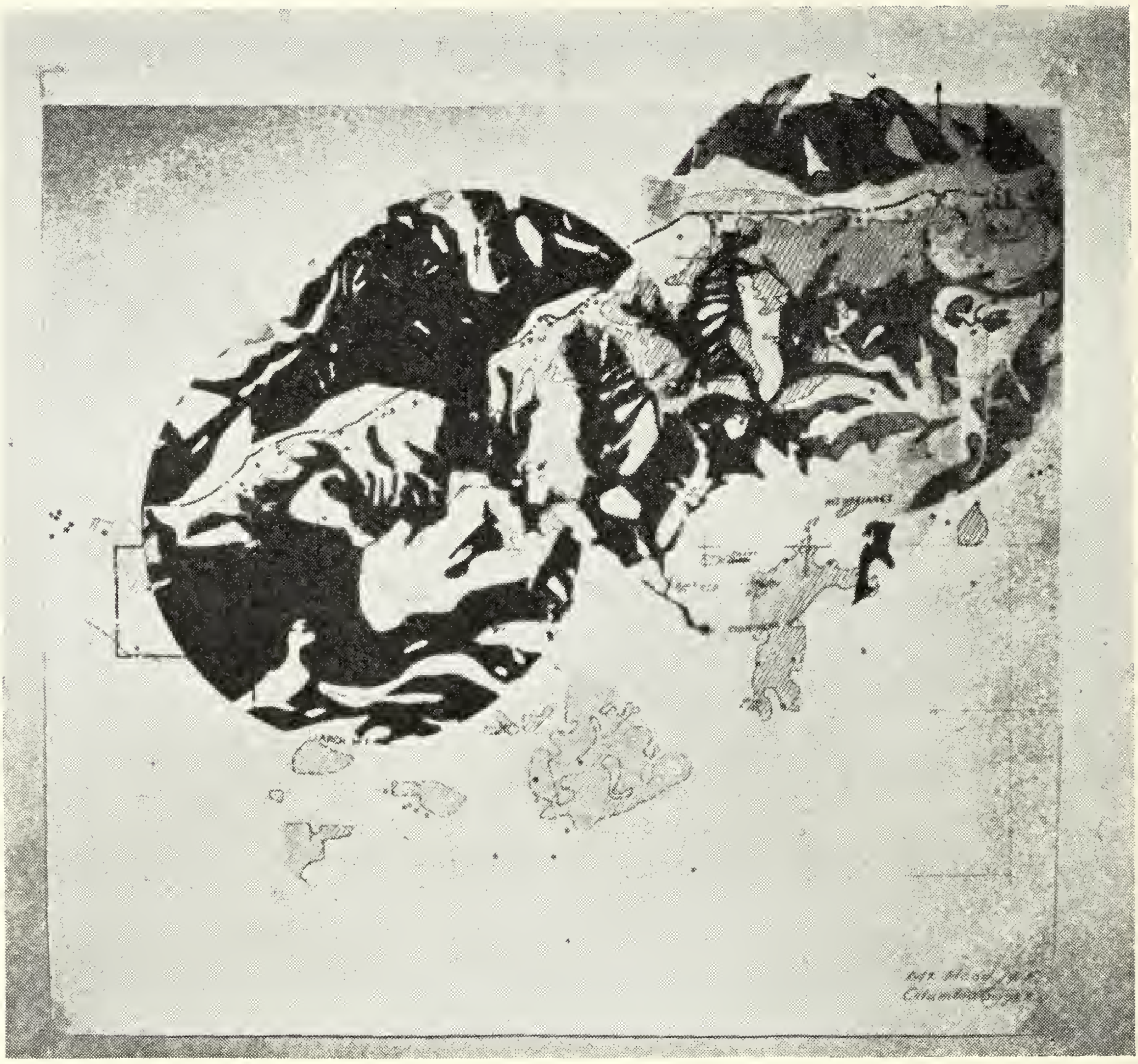


Three photoflood lamps with reflectors are used for exposing. Distance from lowest part of bulb to Ozalid paper is 25 inches; exposure time, 6 to 9 minutes.

points. Visible area is shown in different colors for different points. Tests show that light blue and pink print poorly; yellow, orange, dark red, and green print very well. Disks which do not print well may be stippled with a fine brush and black ink on the opposite side from the color. Ink may be washed off later if it would in any way impair the value of the disk.

Assuming that the ranger district is the unit of area used in planning, the main points in the procedure for obtaining a composite seen-area coverage map are:

1. Prepare a vellum overlay showing the following:
    - (a) District protective boundary.
    - (b) Location and identification of each present or potential lookout point; this should be done with ink.
    - (c) Any information desired which it is felt will influence the location of lookouts; i. e., fuel type, fire occurrence, etc. This should be shown by cross-hatching, preferably with ink or orange pencil.
2. Select by any method desired lookouts which appear to give the best detection system.
3. Orient disks for lookouts selected and held in place on vellum overlay with transparent cellulose tape, see illustration.
4. Place piece of Ozalid paper on table or in frame, emulsion (yellow) side up.
5. Place overlay and disks over Ozalid paper and cover with piece of glass sufficiently large to completely cover map; this is done to hold papers and disks tightly together. See illustration for arrangement used to expose with artificial light.
6. Expose and develop in ammonia chamber. (A home-made chamber can be made at very little expense by using a tin map tube



The final print.

6 inches in diameter over an open container partially filled with ammonia and covered with screen to prevent the map from getting into the ammonia.)

It must be remembered that visible area shown in colors which print well may block out some of the information on the vellum overlay; e. g., protective boundary. However, any areas not covered by seen area show up clearly and the overlay may always be used with the print over a light table if necessary or desirable. If transparency is desired, a thin Ozalid paper similar to vellum may be purchased, or prints made on the ordinary grade paper may be made as transparent as vellum by applying oil or wax.

With such a rapid and economical means of producing composite seen-area maps, it is possible to have on file the coverage obtained from different combinations of detection facilities which may be used under various conditions during the fire season.

RANDOM NEWS NOTES FROM THE FOREST SERVICE RADIO LABORATORY

Since preparing the last résumé of Radio Laboratory activities for Fire Control Notes the entire technical staff of the laboratory has put aside development work several times to accumulate some first-hand field information on going fires. The ability to keep both feet on the ground and remain entirely practical comes only through these intimate contacts with the Forest Service type radio equipment at work and from comments and suggestions from the users.

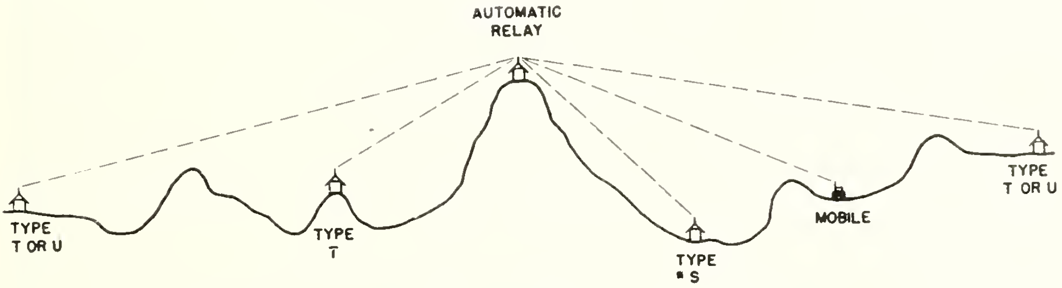
We solicit and welcome reports on the operation of existing types of radio equipment. Although the average user will perhaps not be in a position to make highly technical suggestions for the improvement of the radiophones, his operating experience may suggest possible features of improved mechanical design or more convenient packaging. If some part causes recurrent trouble, we would like to know it so that corrective measures can be taken to eliminate the source of such trouble. It is only through a blending of ideas that we can provide the field with radio units having wide application and high reliability.

Current Projects and Completed Assignments

Equipment Inspection.—From June 1 to September 15, 1939, the Radio Laboratory has handled the technical end of procurement and inspected 353 completed radiophones, in addition to inspecting individual high-frequency radio receivers and miscellaneous test equipment. During the period the distribution by types was: 102 SPF, 4 I, 11 M, 73 S, 103 SV, and 60 T. The total number of completed radiophones inspected since January 1, 1939, is 433 units.

Metal Detecting Device for Saw Timber

The development of this special device for use by NETSA was mentioned in the previous Radio Laboratory news notes, Fire Con-



This sketch illustrating the physical applications of ultra high frequency relaying was omitted from Random News Notes from the Forest Service Radio Laboratory, Fire Control Notes, October 1939. The numerous possibilities of such a relay system are readily apparent from the sketch.

trol Notes, October 1939. The completion of this instrument was delayed both by the recent large quantity of equipment inspection and by several unforeseen difficulties in design. The completed device is being installed in its carrying case as this is being written. In its final form the metal detector will reveal the presence of a tenpenny nail at a distance of about 4 inches from the exploring loop. Larger metal objects such as a 6-inch spike can be detected at a distance of about 12 inches.

Cooperation With Aerial Fire Control

The aerial fire control project, now active in Region 6, recently called on the Radio Laboratory for assistance in developing a special switch and associated electrical circuits for use in connection with the dropping of fire-extinguishing chemicals. It was discovered that even light gage metal cans, containing liquid chemical often failed to burst upon striking the ground. Time-delay electric blasting caps were inserted in each can and the problem presented to the Radio Laboratory was that of providing an electrical system and switch which would prevent the application of current to the caps until the cans of chemical had cleared the trap doors of the dropping chute in the airplane. A special heavy duty switch and link mechanism was constructed in the laboratory shop, and this together with audible and visual warning signals have been installed on the airplane.

Design of Ultra-High Frequency Mobile Radio Receiver

The need for and aims of this project were discussed in Fire Control Notes, October 1939. This project is now current and has progressed to the point of constructing the first mechanically condensed model. Crowding of the component parts to produce a practical size has resulted in somewhat unstable operation. The remaining portion of the job is the coordination of mechanical and electrical features.

Radio Handbook Material and Service Data

Service data on the type T model D radiophone has been completed and will be ready for distribution about October 15, 1939. Service data for the new type M model D is in the process of assembly. Complete service data and a discussion of the applications of the ultra-high frequency type A test set has recently been completed and will be distributed as an addition to the Radio Handbook.

Automatic Ultra-High Frequency Relay

Automatic relaying of ultra-high frequency radio signals was discussed in some detail in the October 1939 issue of Fire Control Notes. The experimental relay which was put into service at the Radio Laboratory in June was taken out of service after approximately 2 months of highly satisfactory operation and taken into the field for trial on a going fire. As the relay was to be put in service to relay a group of type S radiophones the automatic turn-on portion was not used (see discussion in Fire Control Notes, October 1939). The sole purpose of this field test was to obtain the reaction of field men o the possibilities of such a device. Undoubtedly the man most favorably impressed was the head ground scout of the Region 6 scouting unit, who was able to communicate directly from the base amp with his scouts working from 2 to 8 miles away in extremely roken and mountainous country.

The relay has again been set up for full automatic control and is ow operating on an experimental basis from a 4,000-foot prominence bout 22 miles east of the laboratory in Portland. The entire aparatus, housed only in a wooden chest, has been set out in the open ear the top of the mountain where it will be subjected to an extreme ange of temperature and humidity. Valuable information has aleady been obtained relative to precautions necessary to prevent these actors from causing false operation or failure.

Development of the automatic relay does not yet appear on the ork plan or job lists of the Radio Laboratory. The automatic relay dea as applied to forest communication originated in the Radio aboratory, and until we have a further expression of opinion from he field it will be impossible to assign a position of priority to the roject. So far the development has been on the basis of borrowing few minutes for it whenever possible.

Drops From the Grid Leak

Mr. Headley has suggested that this news letter contain an occaional interesting episode relative to radio and its uses in the field. his, together with those items of interest to technicians or those onnected with communication planning, will constitute "Drops rom the Grid Leak."

It seems fitting that we should first define the type of individuals ho carry on the work at the Radio Laboratory. A radio engineer s a man who knows a great deal about very little and who goes along nowing more and more about less and less until finally he knows ractically everything about nothing. A radio mechanic starts out nowing practically everything about everything, but ends in comlete confusion because of his association with the radio engineer.

Every service man who has anything to do with Forest Service ltrahigh frequency radiophones should be equipped with the type A st set. This instrument is fundamentally a grid dip oscillator, but as been provided with a form of self modulation and a means of nploying the device as a rectifier wavemeter for neutralizing and ther operations. The type A test set carries a frequency calibrated ale which, though not intended for frequency measurement work, invaluable in adjusting antennas and matching sections.

Technicians should note that conventional methods and instruments annot be used in adjustment of the type T model D radiophone reeiver. Because of the extremely broad I. F. band in this receiver, hich is necessary to receive modulated oscillator transmitters such s the type S, it is imperative that the Forest Service type D oscillator hannel marker be used for any adjustment of the I. F. channel. he type D instrument will be included in the radio equipment bulletin, and a detailed discussion of its application and operation appears in the service data for the type T model D radiophone in the Radio Handbook.

To avoid confusion resulting from a duplication of type designation on two distinct types of radiophones; i.e., the type I mobile and type I semiportable, the type I mobile will hereafter be known as the type K radiophone. Type I semiportable will be known simply as type I radiophone.

Observations Bring Results.—On September 3, a fire was reported in Boulder Creek on the Descanso District of the Cleveland. Protective Assistant William Clark was dispatched immediately and upon arrival discovered that it was a "set." He preserved the evidence with due precaution and proceeded to corral the fire with the aid of one man, calling in reenforcements for the mop-up This fire reached about one-half acre in size in flash-chamisal type of fuel The control of this fire on a hot day by two men was, in itself, quite an accomplishment.

The next day, accompanied by Ranger Ed Grant, Clark returned to the fire and tracks were found leading up the bottom of a small canyon. Great care was taken by the perpetrator of the violation to insure, so far as possible that the tracks would not be left visible. By very close observation and by working slowly, the tracks were seen in grass, leaf mold, and even in the centers of small bushes, broken twigs and limbs being all that could be seen in several long stretches. After 2 to 3 hours, and about 1 mile of tracking the tracks intersected the main trail and were obliterated by the tracks of the suppression crew members. This point, however, was within 100 yards of a ranch house.

Because of darkness and rain the investigation was postponed, while a call was placed for Rawleigh Taylor, fire prevention officer on the San Bernardino Upon his arrival the investigation continued. A call was made at the sheriff's office and also at the city fire marshal's office in San Diego where the type of set was partially identified as being possibly of a figure 4 variety, operated with the use of rubber bands and rigged up with paraffin so that the sun's rays would release it. Sandpaper was used to strike a match to ignite the powder and set off the brush. (Test of sandpaper on the "set" proved nitrates present.)

With this information, we returned to the ranch and carried on. Sandpaper of the same make and texture was found; then galvanized nails were found of the same size and type as those used in the "set." Next a can of black powder was found. In a corner of the shed, near the work bench, was a pile of shavings. All of these shavings were collected by Taylor and placed in a sack. Next morning a minute inspection of the shavings uncovered several small bits of wood which appeared to have been whittled off of one board in the "set." So far, all of this had been principally circumstantial evidence.

We felt we knew our man. Another trip was made to the sheriff's office for aid, which was promptly furnished by Mr. Carnes who was quite expert on wood identification. We needed particularly to know whether our "chips" fitted the board from the "set" or not. While Mr. Carnes worked with the microscope on the "chips" and the board from the "set," the sheriff with Taylor accompanying, returned to the ranch and brought in their man with a "full confession," a ranch hand who has to answer charges in a Federal court at Los Angeles for a felony and at present is out on $1,000 bail.

Mr. Carnes brought in a report that the chips came from the board, while the suspect informed us he did go down and up the canyon where we found the tracks and that the "set" consisted of two boards, matches, powder, rubber bands, and wax, so arranged that the sun melted the wax, one board holding the matches rubbed them across the board holding the sandpaper and powder, and this in turn set off the brush he had piled around the "set." Our deductions were close, especially as to ingredients used.

The story is long but the moral is short. Always remember that each fire may be a "set," and that it is our job to enforce the fire laws with the evidence present, which means we must watch for, preserve, and use it wisely.—E. A. Grant, ranger, Cleveland National Forest.

DOGS AS A FIRE-PREVENTION TOOL IN THE SOUTH

W. R. Paddock

Senior Forester, Division of Operation, Region 8, U. S. Forest Service

Hounds were used with some misgiving for years. It was feared that the net public reaction might be unfavorable. Experience has shown these fears to be groundless. In one instance, not cited by the author, fire-prevention activity for a district hound practically stopped because there were no more man-caused fires. But the animal was still used in cases of burglary and other depredations with the result that its prevention influence continued because its exploits in other forms of law enforcement were widely known.

Region 8 has about as many fires occurring each year as any other national forest region, and 85 to 90 percent of them are man-caused. Although there has been a favorable reaction to fire-prevention educational and publicity work, 25 percent of the fires on the average are still caused by smokers and 40 percent by incendiaries. In order to prevent the fires caused by chronic carelessness or malicious intent, law enforcement must be resorted to at times. Trailing dogs (blood-

Fire-prevention "bloodhounds" at 6 months of age in Mississippi. These dogs are a cross between the English bloodhound and "Red bone" breeds. The combination produces excellent man-trailers. The dogs were in training when the photograph was taken.

hounds) were introduced into the region more than 10 years ago as a preventive measure, and it was thought that the history, experiences, and conclusions reached might be of value to other fire-control organizations which were considering the use of dogs.

The first dog used in Region 8 was on the Ouachita Forest in 1928. She was a black and tan American hound, named "Donnie," trained as a man-trailer. Later she was used on the Ozark Forest and in 1932 was brought as far east as the Cherokee Forest in east Tennessee and north Georgia. Donnie was owned by a deputy sheriff in Hot Springs, Ark., and had a wide reputation for successful work on all types of criminal cases. About a year ago she died of old age, but her reputation lives on both within the Forest Service and among forest residents where she was known. The exceptionally long chase she gave a firebug in north Georgia is still a topic of conversation in that section.

Certain characteristics of this dog "Donnie" are mentioned here as an example of what a fire-prevention dog should be. Of pure blood lines, distinctive in appearance, she was well trained and had a record for bringing about successful convictions in criminal cases. Later her work was also instrumental in obtaining successful convictions in many fire cases. Her appearance was such that when carried around the country, people took it for granted that she was a man hunter, which unquestionably prevented many fires.

In 1935 two English bloodhounds were purchased by a fireguard on the Cherokee Forest and were available for fire use. These dogs were used successfully for about a year, but died of disease. Later, on the same forest, a chief foreman in a CCC camp obtained a dog and, although it is not known that it was ever actually used, the incendiary fires suddenly stopped in that camp area.

Ranger Roscoe Nicholson of the Chattahoochee Forest obtained a hound trained for man-trailing about 1935. This dog has worked on the eastern part of that forest and also on the Nantahala Forest since that time. She has been a successful trailer, and incendiarism has become a minor cause on the districts where she has been actively used.

The Pisgah Forest purchased a pair of bloodhounds in 1938. Already these dogs have been instrumental in enforcing the law in a number of game and fire trespass cases.

The Mississippi Forest purchased two young bloodhounds from Mr. Gant of Crystal Springs, Miss., who helped train the dogs. He also taught the Forest Service fireguard how to handle them. A point which is important in connection with these particular dogs is that the laws of the State of Mississippi provide that dog evidence is admissible in any court in the State if obtained by dogs that are from Gant's stock and trained by him.

The conclusion reached concerning the use of dogs are:

1. The dogs should be of recognized good breeding, preferably from a breeder who works his stock and has a reputation based on successful convictions.

2. The value of the dog in preventing fires lies both in solving fire cases and in the fact that local residents know the dog is available for use. The dog should be taken around the forest in an automobile and shown off frequently.

3. The dog should have a trained, skilled handler and preferably hould work with one master. Some dogs will work for any handler. Donnie" of the Ouachita was one of these, but they are in the inority.

4. The value of a dog in tracking a man is not necessarily in catch-ng up with him. The fact that the law-enforcement officer is led over e violater's trail makes it possible to pick up any evidence along that rail. Also, knowing the route of travel of the person hunted is often nportant.

5. Personnel in Region 8 favor the use of dogs of the bloodhound ailing type. These dogs are respected by local residents, and it is oubtful if dogs of the "police" breed would be as successful. Writ-rs on the subject state that the percentage of such dogs with a very een trailing sense are in the minority. It could be serious if a dog ere used that was not dependable.

The use of dogs is on the increase in the Southern region, and ost forest officers regard them favorably. Where used, dogs have pparently been a definite deterrent to the firebug. Their use is commended where other measures fail and conditions are compa-ble to those in the South.

Fighting Fire in the Mud.—The first man to arrive on the Camp Branch o. 16 fire on the De Soto, found a 50-acre fire burning on an exposed site fore a 20-mile wind. He had five men on a "hot shot" pick-up, equipped with gallons of water, and knew that reenforcements would arrive within a short me. He attempted to drive the truck through the rough to the head of the e and got bogged down. He got the truck out and made another attempt to ach the head, only to get bogged down again. The truck was finally aban-ned, and the crew started at work on the west flank of the fire. The man charge of this crew did not reach the head until it had burned out.

I personally tried to take a short cut and got bogged down on a road I ew was bad the week before. Had this not occurred I could have arrived the fire at approximately 3:40 p. m., instead of 5:25 p. m.—J. J. Welch, strict ranger.

Who Did It First and Did the Angeles Develop Pictures During the Flight?—ith reference to Clayton Crocker's article on aerial scouting in the October 39 Fire Control Notes, this method of scouting was used very effectively on e Angeles, San Antonio fire of November 1938. This fire burned into the n Dimas Experimental Forest with a very irregular line and long fingers in ry steep country. The pictures told a better story than any ground scout uld possibly give.—W. V. Mendenhall, forest supervisor. (This is apparently e first time we have ever been able to publish a comment on something con-ined in the preceeding quarterly issue. The October number came out ahead schedule. Perhaps the one-lick method has reached Washington.—Ed.)

TRENCHER FIELD TESTS

H. T. Wicklund

Senior Automotive Mechanic, Region 1, U. S. Forest Service

About 40 Bosworth trenchers have been built by the Forest Service in the machine shop in Missoula and distributed to various sections of the country. During the past summer they have been subjected to rigorous use and field tests, calculated to bring out all the faults and induce possible failures. The author of this article has dug deeply into these mechanical problems and presents a most interesting report of his findings. Fire Control Notes solicits constructive criticism of these findings and will publish any other reports which will tend to expedite the development of this promising fire tool.

The success of the trencher depends upon a lightweight unit, an I think the weight should be held as closely as possible to 100 pounds As far as I can determine, the Bendix motor is the lightest moto obtainable which will deliver anywhere near the maximum of 5 horse power. The vertical crankshaft permits the simplest possibl adaptation to the trencher and the best distribution of weight, getting it as far forward as possible so that a larger percentage i carried on the wheel than by the operator.

The motor has shown power enough to make a satisfactory trenc in any kind of material we have encountered—matted brush an roots, deep white-pine duff matted with roots, heavy cedar duff criss crossed by roots, bear grass, rock, gravel, sod, etc. At times whe the going is tough and the machine has to be eased into the work slowed up or backed up to allow the motor to pick up speed, it migh be criticized for being too slow or not having enough power. Thos who would so criticize it, probably would not stop to think of it speed as compared with the speed of clearing construction ahead o any kind of trenching work. Even at its slowest pace, it can mor than keep up with a clearing crew. The machine has its limitation no matter how it is powered. If we applied more power to th present construction, I doubt if the other parts would stand th strain; therefore, more power would call for an increase in th weight of the entire machine, possibly to the point of cutting dow its efficiency of operation.

Each motor which went into service out of the Missoula shop ha had no less than 14 hours of running in, 12 hours with the moto only on a motor stand, and 2 or more hours running in of the completely assembled machine at a motor speed of 3,000 r. p. m. Onl one motor gave us any trouble. It was shipped back to the factor and was replaced with a new motor.

Some trouble has been experienced here and in other regions wit the breaking of the lower connecting rod of the motor.

At the demonstration near Libby on June 13, one of the men wa making a trench across a light-grassy opening, cutting into th ground only 1 or 2 inches. This was not enough to hold the moto speed down to its maximum, and within a minute or two the moto choked and stopped. We took the motor apart and found that th

ower connecting rod had seized the crank shaft enough to blue and
core it. This motor was designed for continuous running under
naximum loads at a maximum speed of 4,000 r. p. m. It stands up
vell in boat operation under these conditions.

In adapting the motor to the trencher operation we work it under
different condition. We have no way of holding our speed con-
tant except by judging the speed of the motor by its sound and
naking it work just enough to keep it at its proper speed. When
he hammers are withdrawn from the ground, the motor keeps build-
ng up speed, helped along by the flywheel action of the swinging
ammers, until it reaches a speed beyond which it is designed to run.
ecause of extreme friction and the inability of the lower connecting
od bearing to get the proper supply of oil it heats and expands until
seizes the shaft. This will either slow the motor down and stop it,
r break the rod and cause other damage to the motor. When the
ammers are raised out of the ground or lifted until the work is so
ght that the motor increases in speed beyond its limit, the throttle
hould be shut down to regulate the motor's speed.

When given the proper instructions, even a beginner will have no
rouble in operating the trencher. On my recent trip one trencher
as given 16½ hours running in almost every kind of material and
nder differing conditions in the forests. At each demonstration the
en were carefully instructed as to how to start, regulate, and handle
e machine. It was then started and worked a few minutes to
emonstrate its operation. The machine was then turned over to
em. On some of the forests as many as 32 men, who had not even
en the trencher before, operated it without having one moment's
rouble with the motor. This leads me to believe that much of the
rouble experienced has been caused by improper operation and care,
ther than inherent faults in the motor.

A few minor things about the care of the motor are: The flywheel
ay loosen if the nut is not kept tightened; the vibration sometimes
osens the gas-line connection; when the carburetor extension is
stened on with the regular carburetor cover screws it has a tendency
vibrate loose—probably bolts and nuts should be used. When
sing spark plugs other than factory equipment, care should be taken
see that they are not longer than the original plugs. If they are
o long, they will strike and break the insulating fiber when the door
closed. A narrow strip of 0.020 metal should be furnished with
ch machine to gage the gap in breakerpoint adjustment.

From the service given by the driving gears, shafts, and housing
semblies under the extreme conditions of the tests, it is indicated
at the general construction is satisfactory. However, some changes
e imperative.

The mounting of the drive-shaft housing in the lower gear case by
reading showed plenty of strength, but the jam nut for locking will
ot keep it from loosening and turning on the threads when in hard
se.

One pinion shaft twisted ⅛ inch in the splines and the gear broke
; four teeth were completely gone, six teeth were broken off for
of an inch from the heel of the gear and there were three sound
eth left. The markings on the sound teeth indicated that they
ere not getting a bearing the full length of the teeth. The remain-

ing teeth were still delivering power to the hammers when I stoppe the machine to locate the noise. The ring gear teeth were in goo condition except where the broken teeth of the pinion slipped ove them and rounded the edges. The work the trencher was doin when the gears broke was the hardest it had ever encountered t my knowledge. It worked 4 hours pounding against hard hemloc roots in deep duff soil.

The strain of the work done by the gears and hammers is to much for the mounting of the gear case covers with ¼ by ½-inc fillister head screws. It is impossible to keep them tight. Afte they are tightened a few times, the threads strip out of the aluminu case. During the last part of the trip there was no way to keep o in the case. I had to stop the machines occasionally and put oil i so the gears would not run dry.

The ⅛ inch, No. 17 Garlock packing, used as an oil seal betwee the gear case housing and the driving flange, makes a very poor se and cuts out after a few hours' service.

The method of driving the hammer hubs through friction agains a flange which is keyed to the shaft is satisfactory. We were trou bled a little with the hub nuts becoming very tight, but we were no troubled with any slipping.

The hammers broke up badly in the harder material—36 hamme on the trip. Twelve showed a distinct flaw in the casting at th joining of the shank to the cross head, and the others showed clea breaks in different parts of the shanks. The case-hardened bolts o which the hammers are mounted stood up fine, showing only a goo polishing where worn by the hammers. The threads had not bee annealed and they broke off badly in the nuts.

The general construction of the frame and mounting of the moto are satisfactory. There is a little tendency for upper motor mount ing bolts to loosen up, but they can be watched and tightened wit a screwdriver when they come loose.

There are two things wrong with the mounting of the handles o the square rear-frame tubing. When operating the trencher th handles can't be tightened enough to keep them from working dow the tubing, making the operation difficult and constant readjustmen necessary. With the present mounting, the handles do not exten from the machine at the proper angle. When the motor mountin plate is horizontal, the handles should also be horizontal, or the would be even better if they were above the horizontal line. A present they set at about a 7° angle below horizontal.

When operating with the hammers throwing to the left, a lot c the dirt is thrown up within a few inches of the air cleaner, causin it to fill up much faster than it should. Ordinarily the air cleane is very efficient and keeps practically all the dirt out of the motor.

Self Service.—We left immediately for the scene of the Plantation No. 24 Fi on the De Soto and arrived 10 minutes later. We tried to use a three-pat road through the fire to get to the head, but because the smoke was so thic and hot we had to drive out of the burn-over and get into the rough. Whe we got into the rough we noticed our gasoline tank was on fire. We immed ately turned the hose on the fire and in about 30 seconds had it out.—G. Boddie, project superintendent.

LESSONS FROM LARGER FIRES OF 1939—TAKEN FROM REPORTS ON FIRES OF OVER 300 ACRES

Edited by Roy Headley
Division of Fire Control, U. S. Forest Service, Washington, D. C.

The July and October 1939 issues of Fire Control Notes carried "Lessons Learned" from the larger fires of 1938. In this issue, the larger fires of 1939 in the Eastern, Southern, and North-Central national-forest regions are reviewed. Eastern fire-control men will thus have a chance to benefit from 1939 experience in preparing for the spring season of 1940. The fact that a "lesson" is quoted does not necessarily mean that the editors agree. It is possible to learn the wrong thing from an experience. Lessons learned in Western regions in 1939 will be reported in the April and July issues of Fire Control Notes. Statistical summaries for 1939 should be available for the July issue.

Eastern Region

George Washington—Trout Pond Fire—890 acres.—(This national forest is noted for the cooperation which has been built up. Cooperators are relied upon for detection as well as suppression on the million and a half acres under protection. In this case, however, the fire occurred in a gap and was not visible to local residents until it had become a fairly large fire. This emphasizes the limitations of cooperative detection. The forest report says the lesson here is to provide another tower and another regular lookout man. But the regional forester says of the fire that it is "primarily a dispatching failure following detection. Demonstrates a need for more thorough training in follow-up of suspected smokes. Corrective action has been taken." His reason for such a statement is that the report shows that the fire was seen from a lookout tower 4½ miles away, an hour and 4 minutes before the first cooperator discovered the fire. The lookout man and the district ranger both failed to require a definite check on this smoke, thinking it was probably an expected case of controlled brush burning. A cross shot from another lookout tower would have disclosed that it was not, but so would have "the all-important check of every smoke threatening Government land." The obvious lesson here is not to take chances with reported smokes which may be wild fires.—Ed.)

A moving-picture tour of the district had just been completed and all sawmill operators and prospective debris burners had been contacted. This smoker fire occurred after a rather intensive fire prevention campaign aimed at this particular area and woods operation.—Unsigned forest report. (Showing that, try as we may, our prevention efforts sometimes fail to impress sufficiently the one man we need to reach.—Ed.)

Because of the fact that it was crop planting time and good weather, all of the wardens and warden crews in that vicinity were at work in the field and were not instantly available. This resulted in delayed action of first-line suppression crews. The only action available under these circumstances is the establishment of paid standby crews which is hardly justifiable on the basis of past fire occurrence in this section of the forest.—Unsigned forest report. (The cooperator assembled eight men and got away in 50 minutes after receiving the report of the fire.—Ed.)

George Washington—Chestnut Ridge Fire—872 acres.—This fire on March 9, under very serious burning conditions, was probably caused by children living in the vicinity.

A prevention campaign in that area had not been initiated, largely because of the rapid transition from safe conditions to high danger. Ten thousand people live within and immediately adjacent to the district.

This fire caught the preparedness organization of the district napping. Towers were not manned. Weather stations and district fire truck not in operation, and the district ranger not in touch with his dispatcher. Failure to recognize emergency conditions and to build organization on the basis of emergency conditions results in fires of this class.

Once organized the suppression action was satisfactory. However, because of lack of preparedness it required 3½ hours to get the suppression organization to the fire. The result was a large fire, and the lessons learned by all concerned are that regardless of previous weather, conditions may change very rapidly during the early spring, and that the field organization must be kept on its toes.—Unsigned forest report.

A complete failure of district ranger to recognize degree of fire danger and plan accordingly. Corrective action has been taken. The most valuable lesson in this case involves the continuous daily use of fire-weather stations to determine degree of danger following rain. Very rapid changes involving only a few hours from no danger to high danger are to be expected during March, April, and May.—R. M. Evans, *regional forester.*

George Washington—Hartman Knob Fire—768 acres.—The area in which the fire occurred was classified as a high incendiary risk, a medium smoker risk, and a medium debris-burning risk. District ranger had made 49 prevention contacts, and had employed a patrolman for the area who had made more than 100 prevention contacts. Motion picture on fire prevention had been shown in the schools adjacent to the area during the month prior to the fire. At least 75 percent of the residents of the area had been contacted immediately prior to the fire. On the day of the fire a patrolman was located within this area to supplement local residents in detecting fires. A suspect list for the incendiaries of the area had been prepared, but none of the suspects listed were responsible for the fire unless in an indirect way which investigation did not disclose. All individuals on the suspect list had been contacted.

Because of the large number of sets, it was handled as four separate fires. Coordination was difficult because of the large amount of smoke, the topography, and the search for the incendiarist.—Unsigned forest report.

Supervisor Howard got the firebug while he was still setting fire, and he got 2 years.—D. W. Beck, Fire Control, R–7. (It would be helpful to know the motives of this individual incendiarist. Looking through the hindsights, could the aggressive prevention campaign have been altered so as to reach this particular man?—Ed.)

Suppression action good under the circumstances. Had supervisor, assistant, and district ranger been equipped with radio, it would have aided in planning, coordination of crew efforts, and speeding up suppression action on the large number of fires. District ranger took too long to get to fire. Corrective action has been taken to avoid future like errors.—R. M. Evans, *regional forester.*

Southern Region

Appalachicola—Five fires burning a total of 3,059 acres on Wakulla Ranger District.—(This district which was only placed under national forest protection this year illustrates what forest officers are up against on new units. The number of incendiary sets covered by each of these 5 reports is indicated respectively as 3, 5 or more, 6, and in each of 2 instances 20 or more. In one instance District Ranger McCullough says, "The initial crew arrived in good ime, but the fires were still being set after the arrival of the first rew. The scattered nature of the sets made it impossible to attack hem all at once. This fire showed that our fire-fighting set-up on his unit was still unable to cope with the incendiary situation in pite of mounted patrolmen and additional equipment." His comnent on another report is, "It seems that the cattlemen are deternined to burn sufficient area to graze their cattle. The scattered nd well-timed and spaced number of sets convinces us that whoever s setting these fires is an expert. Increased effort is being made by he personnel both in watching for the responsible parties and in public-relations work." In a third case, where the number of sets vas 20 or more, he says, "Found that the person setting the fires vould continue to do so all night." Of the fourth fire, he reports hat, "This fire brought out the fact that even our cooperators could ot be trusted. Suspicion for this fire falls on one of them. It eems that even at the risk of life or limb, the cattle must have urned woods." The use of bloodhounds is repeatedly referred o.—Ed.)

This area has always been burned off, and although intensive preention work has been carried on, there are still many who will set res. As to the tactics on these fires, they were about as good as can e expected, considering the fuel types, equipment available, and he fact that the fires were set in many places. In such cases some f these fires will get above 300 acres.

Ranger McCullough's statement that law enforcement and the use f bloodhounds are needed is true. Arrangements were made to btain dogs from the State penitentiary in April. They were called n a fire in early May and caught an incendiary. The case is now n Federal court, and there have been no incendiary fires since.—I. O. Stabler, *acting regional forester.*

Ozard—Tie Fire—385 acres.—Two things are significant as a reult of this fire. First, the timber-stand-improvement areas on this disrict are increasing the fire hazard. The bark on the treated trees as broken and most of it is hanging to the standing trees in shreds or flakes. The sapwood on the treated trees that are standing is decayed and a part of it is clinging to the snags in shreds. The fallen treated timber is dry, most of it does not lie flat on the ground, and it burns fast and hot. This fallen timber delays line construction.

The second significant thing is that a period of years of no incendiary activity is not always indicative of progress being made in the prevention of incendiary fires. The prevention work which had apparently been successful must be harder and of greater intensity.—Fred G. Ames, *district ranger.*

Holley Springs—Concord Church No. 49 Fire—400 acres inside, 10,000 outside.—(Although over 4 inches of rain fell during March when this fire occurred, it is classified as an "unusually dry" month. The fire "had been going for several weeks outside and had neither been surveyed nor worked until it entered the forest." Visibility was almost zero because of smoke from many fires. This fire was corralled about midnight the first night and left without patrol. It broke out the next day.—Ed.)

With due regard for the fact that this fire was the ninth in a series of fires and false alarms on the Holley Springs unit on March 23 and that it entered from the outside, the following irregular action and failures occurred:

1. Plans had not been made to provide manpower in excess of regular CCC.
2. With a fire of this size burning south of the boundary and moving toward it, some patrol should have been dispatched to the road near the boundary.
3. Men should have been left on the fire overnight as a patrol.
4. When the fire was found going the next morning, it should have been scouted to determine the amount of work to be done, and the dispatcher promptly notified of conditions.

Shortage of manpower and transportation brought about by an emergency condition beyond our planning and expectation was responsible for the size of this fire.

Plans to provide manpower and transportation beyond our regular CCC manpower should make the recurrence of the Concord Church fire impossible.—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Plantation No. 24 Fire—1,682 acres.—(When discovered 5 minutes after known time of origin, this incendiary grass fire was 3 acres. Report and get-away took 5 minutes. Three miles of auto travel, 10 minutes. When reached by the first crew of 17 men, 20 minutes after origin, the fire was 20 acres. But it burned 1,682 acres, including 870 acres of plantation, before it was corralled 10 hours and 25 minutes after origin. In one place wind velocity is reported as 2–19 miles; in another, 25–38 miles. Five days since last rain of 0.28 inch. Number of chains per man hour, 2.3. Much confusion and disorganization on the line. Maximum number of men engaged, 65.—Ed.)

The underlying cause of this fire was ill feeling between two residents, and a desire to involve the Forest Service in their personal affairs. Which family caused the fire was not determined. Another possible cause was to destroy cattle rustling in the path of the fire or to throw blame on another resident, as it is generally accepted by local residents that the feelings are strained between this man and the Forest Service.—Lester P. Schaap, *district ranger.*

The fire tractor arrived at the fire around 9:30 a.m., but no one was left to direct it where to go. In the process of getting where the driver thought best, the tractor got hung up on a stump and stayed there for nearly 2 hours.

The initial dispatch of manpower and supervision was sufficient, considering that they were backed by special equipment and the fire was relatively small upon arrival. There was, however, a serious delay in sending reenforcements after the fire had definitely gotten away from the first crews. It was not until 5 hours and 35 minutes after arrival of the first crew that adequate reenforcements arrived on the fire.

The initial tactics used by the fire boss were correct for this fire, and had the heavy equipment functioned properly, the fire would have been held to less than 100 acres.

The failures and irregular action in suppression may be summarized briefly as follows:

1. The fire was not scouted to determine amount of work to be done and manpower needed.
2. There was no contact or coordination between suppression units on the fire.
3. Communication was not satisfactory between the fire line and dispatcher until after the arrival of the ranger with the mobile I radio set.
4. Reenforcements were not sent soon enough. This was the direct result of the fire boss' order via radio at one time to send no more men. With the high values in this area (plantation) there should have been no attempt to economize on men, especially when the manpower was available and no other fires were going.
5. District ranger should have contacted the dispatcher earlier in the day because of the high danger and the chance that he might need to leave the other work he was on.
6. The district organization of men on the fire line does not provide for bucket men (what are they?—Ed.) and it is noted that the "water gave out" at a crucial moment.
7. The firebreak along the plantation boundary had not been maintained, and as a result offered no barrier to the fire spreading out of the plantation—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Leaf No. 35 Fire—416 acres.—(Fire was 75 acres when discovered 2 hours and 17 minutes after guessed time of origin. It spread 25 acres during the 53 minutes required for report, get-away, and the travel.—Ed.)

Low visibility accounts for the size of fire when discovered.

There were five sets and the purpose of the fire was to provide sheep range. The exposed ridge site and high winds made suppression difficult.

A fire usually occurs in this location about the same time each year. Next year it is planned to patrol these areas closely in an effort to prevent the fire or catch the incendiary.—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Convention No. 46 Fire—319 acres.—(This incendiary fire with five sets was discovered 22 minutes after the guessed time of origin and at that time was estimated to be 25 acres. It spread 50 acres during the 43 minutes required for report, get-away, and 18 miles auto travel.—Ed.)

This fire was discovered by a competent leader with four men while on patrol. However, safety regulations prevented attack of the fire until arrival of a qualified foreman some 40 minutes later. (If this sort of thing is really necessary under the CCC safety regulations, surely it could be changed upon proper recommendation to CCC authority.—Ed.)

Full use was not made of all power equipment available. The fire tractor was not put into action, although it was on no other fire.

Failure to hold line after it was built contributed to the acreage on this fire.—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Derrick No. 36 Fire—961 acres.—(This stockman, grass, incendiary fire with five sets was 50 acres when discovered 1 hour and 35 minutes after guessed time of origin. It spread 50 acres during the 1 hour and 10 minutes required for report, get-away, and 18 miles auto travel. First crew dispatched included 17 men. First reenforcements reached fire 17 hours and 40 minutes after discovery. Output of held line per man-hour was 3.5 chains.—Ed.)

This fire occurred during a period when sickness in camp and high fire occurrence seriously reduced available manpower and supervision. As a result, the fire was undermanned. It was discovered by an enrollee leader and fire crew before it was picked up by the lookout man, but attack was delayed until a "qualified" foreman could arrive at the fire to take charge. This action was to comply with CCC safety requirements.

The chief lesson to be learned from this fire is to develop reserve supervision and manpower for those peaks of occurrence and hazard which happen annually.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—University No. 28 Fire—1,238 acres.—(Another grass, stockman, incendiary fire but with only one set. This time the lookout man snapped in with discovery within 4 minutes after guessed time of origin, when the probable area was one-tenth acre. But report took 42 minutes. In the 65 minutes required for report, get-away, and 9 miles auto travel, the fire spread to 350 acres. Wind velocity reported as 13 to 18 miles per hour when fire was first reached and during biggest run.—Ed.)

This was one of six fires which occurred on the Biloxi on March 16. It was an outside fire which entered in spite of the efforts of a State Forest Service crew. United States Forest Service manpower had been depleted by the unexpected occurrence to a point where this fire was somewhat under-manned.

Adequate planning to provide extra manpower during these peaks of occurrence and hazard will be made before next season.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—Bluff Creek No. 26—393 acres.—(Another stockman, incendiary, grass fire, but with 10 sets, while wind velocity was 13 to 18 miles per hour. The towerman with 5 men started work 15 minutes after discovery, but the fire had grown from 2 acres when discovered to 30 acres.—Ed.)

This was one of 6 fires which occurred on March 16 on the Biloxi. This unexpected occurrence depleted manpower resources to a point where it was not possible to man fully all of the fires.

Even with adequate manpower, 10 sets in this location and fuel type would mean a large fire under hazardous weather conditions.

Close watch on known suspects and planning for extra manpower will help prevent these fires and insure adequate strength of attack during hazardous weather.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—Biloxi River No. 25 Fire—518 acres.—(Another stockman, incendiary, grass fire with 14 sets during a 13- to 18-mile per hour wind. Although discovered in 5 minutes after guessed time of origin, when fire was 1 acre, it reached 200 acres during the 1 hour and 10 minutes required for report, get-away, and 20 miles auto travel.—Ed.)

The 14 sets were strung out over 1½ miles. The fire had made its run by the time the crews arrived.

The fire was man-caused for grazing purposes. A very few individuals will attempt to get their "burn" each year in spite of intensive educational work and law enforcement. There are very few accidental or careless fires in this vicinity. Therefore, prevention work is being concentrated on the known suspects.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—Camp Branch No. 16 Fire—419 acres.—On this fire, if the one-half ton pick-up which was equipped with a Panama pump and 55 gallons of water had not bogged down, a successful attack could undoubtedly have been made on the head.—V. B. McNaughton, *fire assistant.* (Illustrating why Region 8 is interested in four-wheel drive trucks.—Ed.)

The fire was not scouted and no one reached the head until it had burned into the forks of the creek about 1 mile south of where the initial attack was made.

This fire illustrates what happens when the initial action on fires in this country is wrong. The climatic conditions and fuel types favor an extremely rapid rate of spread on practically all of our fires, and it is imperative that we get a crew on the head of the fire as soon as possible.

For this reason we dispatch a small crew on a "hot shot" pick-up and follow this unit with a 20-man crew. The small crew, upon reaching the fire should go to the head and take whatever action is necessary to check it. As I see it, there are only two possible conditions present; either (1) they can hold the head by direct attack, or, (2) they can't. In the latter case, their only alternative is to backfire against the head and depend on the follow-up crew to handle the flanks.

The mistakes made on this fire were discussed at a personnel meeting. It was brought out that we were not adequately equipped to construct a line through sedge grass from which to backfire. The council tools were not effective in deep grass, and it is hazardous to attempt to backfire in the open with a small crew without some sort of a break in the cover type.

With this in mind we tried using a grass cutter blade to cut a line through heavy grass. This proved to be very effective, and it is planned to incorporate a blade as part of our fire-fighting equipment.

The cause of this fire has not been definitely determined. Evidence of wood haulers being active in this vicinity at first led to the belief that it was started accidentally by someone getting wood. Later investigation, however, brought out the possibility that it may have been started by a local firebug who has not been identified to date.—J. J. Welch, *district ranger.*

Bienville—Ludlow Fire No. 20—1,056 acres.—(The report shows that the fire started one-half mile outside the boundary. Discovered at 10 acres, 1 hour and 14 minutes after guessed time of origin, and reported to dispatcher. But report time is 45 hours and 6 minutes. Hence, with 5 minutes get-away time and 1 hour and 5 minutes for 4 miles travel on foot, a total of 46 hours and 16 minutes elapsed from discovery to arrival. The fire was 500 acres when reached. It did not enter the forest until the second day after it started.—Ed.)

It is known at this time that a crew should have been dispatched to the smoke shortly following discovery. It does not hold, however, that this procedure can be followed on all smokes, the number and places of occurrence making this prohibitive.

It is planned to adopt a policy of closer investigation of doubtful smokes on days of poor visibility when no crossing-out is possible, even at the risk of increasing the false-alarm cost. Better a false alarm than a 600-acre fire!

Every fire training meeting or conference stresses the need of exercising good judgment in all phases of fire control. It is a little unfortunate that this qualification must attend an individual's every action in fire control. Very often, certain action which has merited commendation because of its practical application in hundreds of previous cases, falls down in a particular case, and the cry "poor judgment" is raised and not altogether unjustifiably, as with this fire.

The lesson to be learned from the Ludlow fire is definitely this, in my opinion: Where the slightest doubt exists in the mind of a dispatcher or towerman as to the location of a smoke, because of poor visibility or any other reason, prompt investigative action should take place. Although it was known that debris burning was being done in the affected area, too great a chance was taken on these particular hazardous days to let a smoke of this nature, never definitely located until the third day, go uninvestigated. Out of this lesson should come an unqualified policy of action on smokes which literally cry out: "I need investigating!"

It is recommended that some authorization be granted whereby fire guards may be dispatched to investigate or suppress endangering fires without incurring personal transportation costs.—W. W. Bergoffen, *district manager.*

THE BIG FIRE OF THE YEAR

Everyone remembers the famous Tillamook fire of 1933 which urned over a net area of 267,000 acres between Portland, Oreg., and he Pacific Ocean. More than two-thirds of this area was virgin tim-er, estimated to contain 12 billion board feet. The total estimated oss to industry, labor, and the public was $350,000,000. National-orest land was not involved.

On August 1, 1939, came the news that the old burn was on fire gain. Later in the month it definitely threatened the Siuslaw Na-ional Forest and the protection area to the east of it. On August 31, ith the fire practically controlled, Region 6 summed up the situation n a telegram as follows:

> The Tillamook fire started 1:30 p. m., August 1, Sec. 14, T. 1 N., R. 6 W. at gging operations. Reported either spark from moving donkey or careless noker, probably an employee. Present area estimated 200,000 acres. Covers outh two-thirds of 1933 burn and extends on east and south 1½ to 4 miles eyond 1933 burn.
>
> South side all controlled by Forest Service. About 50 miles fire line including oots. Using maximum 1,350 FF men and 150 CCC enrollees. Reduced to 200 F and 50 CCC.
>
> East side and east half north side controlled and held by association and ggers. Maximum number of men north and east side of 225 WPA, 775 loggers id by operators, 200 CCC, 350 civilians paid by association. Monday reduced 50 CCC, 125 loggers and 115 association. West and northwest 250 WPA and civilians, 100 CCC have made control section reasonably safe. Mop-up con-ued. Uncontrolled section dangerous but probably does not threaten Siuslaw rest protection area. Damage to new area burn on south severe. Nearly all mber killed. Damage east about 25 percent all large second growth. No tional forest land burned. About 3,000 acres protection area burned. Esti-ated expenditures FF to August 30, $168,000.

In the September 1939 issue of "Six Twenty Six," Thornton T. unger, of the Pacific Northwest Forest Experiment Station, wrote he following which he entitled "It Hurts My Eyes."

> Such was the comment of a Portland business man about the forest fire smoke at invaded our city last month—it hurt his eyes. But did he stop to think w much those fires hurt? Did he think of the destruction of forest capital, the killing of seedlings and saplings that would have been the forests of the ture, of the soil wastage and erosion that will follow, of the ruination of adside scenery, of fishing streams, and happy hunting grounds? Every million ard feet of mature trees destroyed beyond salvage in this fire means the imme-ate loss of 1 man-year of labor, and many millions of feet have been destroyed ready.
>
> The reburning of the Tillamook and Wolf Creek burns, much of which had ready become restocked naturally with young trees, put off indefinitely receiv-g any forest income from these productive hillsides. Every 100,000 acres of edling and sapling forest destroyed means an annual reduction of perhaps 50 illion board feet (enough to supply one good-sized sawmill) in the industrial oduction of some community in the years to come. Truly smoke hurts the es and it will later hurt the eyes of our visiting tourists to see these scars on ir landscapes. But it also hurts our pocketbooks, and those of our children, hen we as a people build campfires in dangerous places, discard cigarettes in e woods, and do land clearing in an irresponsible way.

FOREST SERVICE LANDING FIELDS

F. W. Funke
Fire Control, Region 5, U. S. Forest Service

The increasing use of aircraft in fire-control work, coupled wit the transition to larger and faster ships, has focused considerabl attention on the factors which finally determine the usability of landing fields. A recent survey of private landing fields adjacent to national-forest areas in Region 5 reveals the rather astonishing fact tha very few are suitable for use by Forest Service contract aircraft.

A discussion of landing-field requirements involves examinatio of many technical questions which, while apparently complex, i reality are quite simple if the basis is understood. Incidentall many of the technical questions have little relation to our proble since necessities of the job and limitations of the site will usuall determine what can be done.

Forest Service landing fields may be grouped rather loosely i three classifications:

Class 1.—Field suitable for landing and take-off with capacit loads, using multimotor ships.

Class 2.—Field suitable for capacity load landing and take-off b reconnaissance ships up to 4,500 pounds gross, and capacity loa landings but light take-off by multimotor ships.

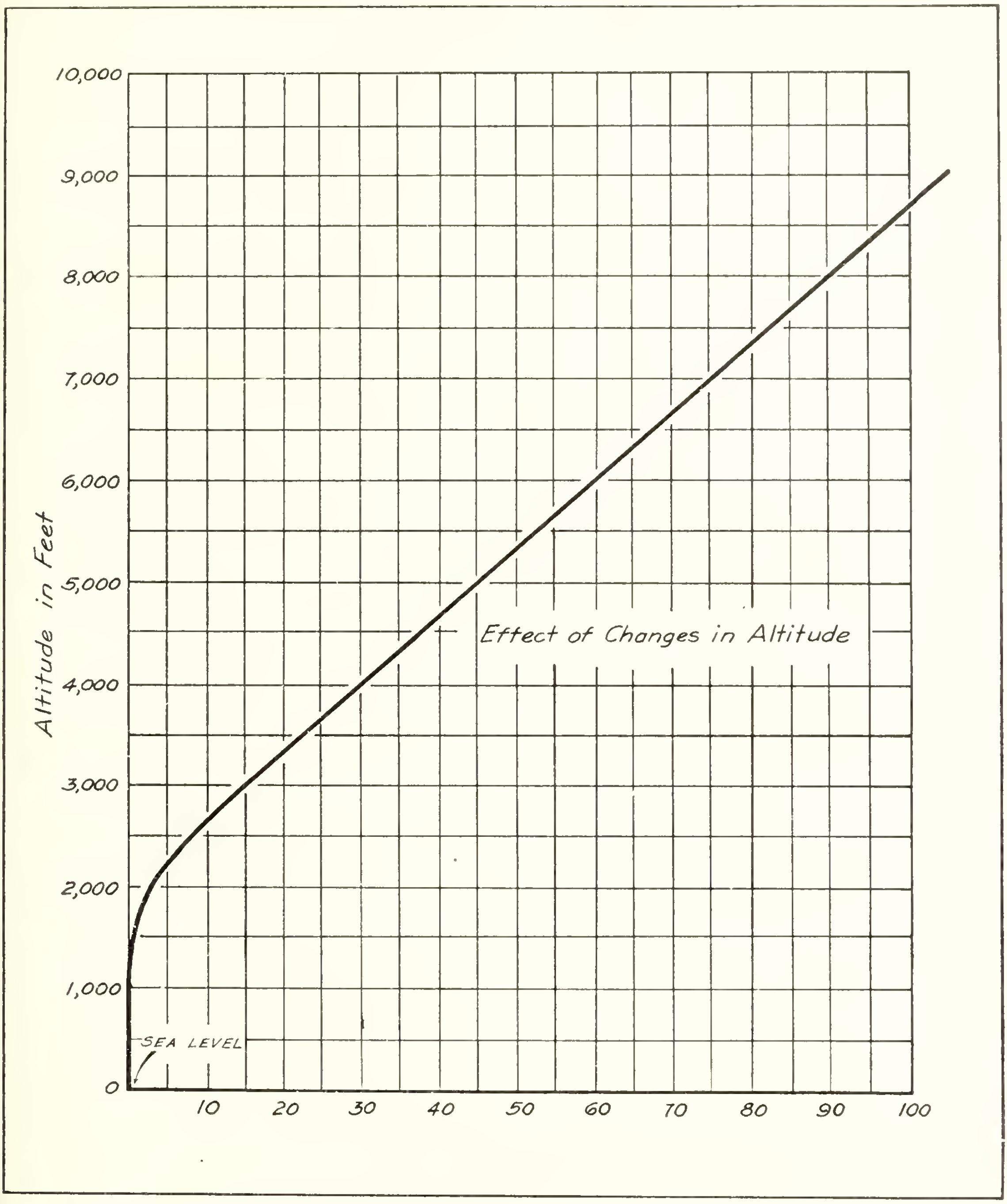
Class 3.—Emergency landings only.

The Relation Between Gross Weight, Horsepower, Propeller Typ and Runway Length

The average layman thinks of an airport or landing field as an flat area on which is parked one or more small ships of the Taylo craft type having a gross weight of approximately 1,400 to 1,60 pounds. Such fields usually are less than 2,000 feet in length regar less of the altitude at which they are located. However, the lengt is entirely adequate for small ships. Depending on the type, suc ships are equipped with motors developing 40 to 65 horsepowe resulting in a gross weight-horsepower ratio of approximately 2 Flight under adverse air conditions is seldom attempted, and in mos cases flights are made in the light condition. Capacity loads are th exception rather than the rule.

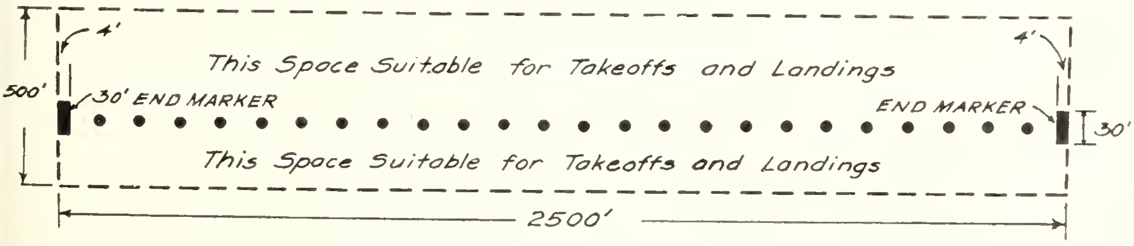
Forest Service reconnaissance ships used in Region 5 have a gros weight of approximately 4,500 pounds and are equipped with 32 horsepower motors, representing a ratio of approximately 14 pound of weight per horsepower. This ratio is normal for many commerci aircraft in this weight class and may be accepted as the ratio in mos ships which will be used in Forest Service work for some years t come. Several multimotor ships in the transport class have a rati of 9 pounds per horsepower.

The trend pointed out is indicative of a number of things. Hig speed wing sections usually are smaller than the low-speed air foi Actual load carried on the high-speed wing is much greater pe



The above graph indicates the approximate increase in effective landing strip or runway length necessary to accommodate aircraft operations from airports at various altitudes above sea level. Factors affecting landing strip or runway lengths, other than altitude, have been taken into account in establishing minimum lengths for operation at sea level.

LANDING AND TAKEOFF RUNWAY


4'
4'
500'
30' END MARKER
END MARKER
30'
This Space Suitable for Takeoffs and Landings
This Space Suitable for Takeoffs and Landings
2500'

Solid lime dots 4 feet in diameter spaced at intervals 100 feet. End markers 4 feet wide, 30 feet long, solid lime line. Landing strip area 2500 feet long, 500 feet wide. Smooth and clear crushed white rock, if available, will provide permanent markings.

square foot than on slower types. Higher cruising speeds require greater horsepower per pound of weight carried.

In the small sport-type ship, the wing loading is relatively light with the result that the ship will take off at low air speeds. However, because of larger wing surfaces and consequent head resistance, cruising speed is low and the horsepower required to drive the ship at a given speed is somewhat out of proportion when considered in the light of the performance of higher speed aircraft.

Conventional designs are required to take off in 800 feet of run at sea level and have a landing speed of approximately 65 miles per hour. This is an ideal performance, but is seldom attained in actual practice because of atmospheric conditions. However, for small ships having cruising speeds of approximately 80 miles per hour, the load carried by the wings is so small that the ship will take off at speeds of 40 to 50 miles per hour, which, of course, is quickly reached in a short run.

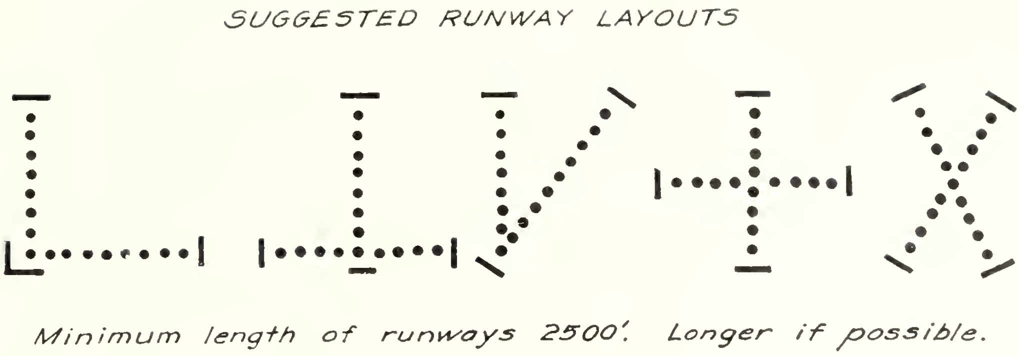
Heavier ships with increased speed ranges, having smaller wings and heavier loading per square foot of wing area, depend on increased speed to get the lift necessary to take off. Ships of this type can be pulled off at speeds of approximately 60 miles per hour, but rarely have reasonable control until at least 80 miles per hour is reached. Again, greater power and longer run is required to start a heavy ship and reach take-off speed.

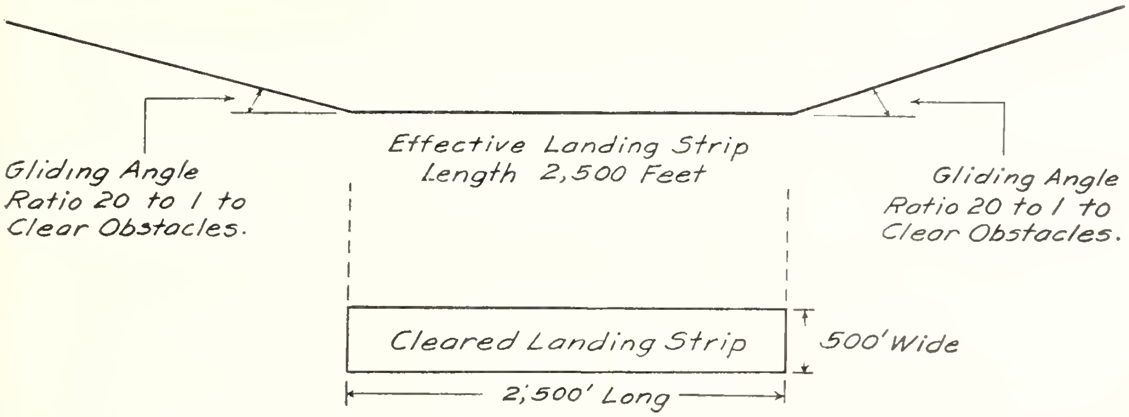
Three types of propellers are available—the fixed-pitch, controllable-pitch, and the constant-speed unit. The fixed-pitch is the cheapest and more common type. Pitch is usually determined for best performance under one of two conditions. High pitch gives best speed and economical operation once in the air. Low pitch gives best performance in getting the ship off the ground but is not efficient once in the air. For this reason practically all operators have fixed-pitch propellers set for speed performance in the air, a very undesirable setting for take-offs with capacity loads at altitudes above sea level, since the full power of the motor cannot be developed. The controllable-pitch propeller provides a manual control so that low pitch is instantly available when needed either on take-off or in vertical currents, and high pitch is available for cruising. The constant-speed unit, the most recent development and the best, automatically varies the pitch of the propeller so that maximum traction is taken for the horsepower being used.

The Relation Between Altitude, Atmospherics, and Runway Length

A 2,500-foot runway clear of obstructions is considered to be the normal requirement for landing fields at sea level. Altitudes above sea level require additional length because of lighter air and the greater rolling speed which must be reached for take-off. Field surface determines to a great extent the ground speed which can be developed for take-off. Loose sandy surfaces are termed "slow;" hard compacted surfaces are "fast." Runways should in all cases be free of rocks and unevenness insofar as possible. The illustrations indicate the percent increase in effective runway length required for various altitudes.

The air drainage in the vicinity of a landing field is extremely important in limiting the loads which can be carried off the field.




Gliding Angle Ratio 20 to 1 to Clear Obstacles.
Effective Landing Strip Length 2,500 Feet
Gliding Angle Ratio 20 to 1 to Clear Obstacles.
Cleared Landing Strip
500' Wide
2,500' Long

2,500-foot runway clear of obstructions is considered to be the normal requirement for landing fields at sea level.

ertical currents or cross winds also are important. The Truckee nd Beckwith fields in Region 5, while having sufficient length for ll purposes, are so affected by unstable air that it is impossible to ake off with more than about 40 percent of normal load. Even n the light condition a ship must be pulled off, after which the hip mushes or staggers along without making altitude until suffiient air speed is reached to permit control. This is extremely ncomfortable, aside from the fact that it is far from safe. A heezy spark plug which would cause the motor to momentarily drop 00 or 200 revolutions per minute would cause a crack-up, since it ould be impossible to keep the ship in the air.

High temperatures, particularly when accompanied by low humidy, make take-off difficult even with light loads. In a number of ases during the current season it was necessary to restrict loads approximately 50 percent of the capacity of the ship, in order to nsure safety in take-off. If, however, additional runway length ad been available it would have been possible to carry greater loads. rom the standpoint of flight control it is perfectly safe to pull a hip off the ground before it reaches the normal sea level take-off peed. However, sufficient runway should be available ahead of the ake-off point so that if the ship does not lift and settles back to he field, the pilot will have enough field to bring the ship to a stop ithout ground-looping.

Safety in flight should be paramount. Obsolete or poorly maintained equipment should never be used. No fire or fire-control job of such importance as to risk life in unsafe equipment. Fixeditch propellers have little or no place in fire-control work where it is necessary to fly close to the earth and subject the equipment to turbulent vertical currents. The fixed propeller will seldom be able to pull a ship out of a strong down draft without considerable loss of altitude. As a companion to good equipment, the landing fields should be of sufficient length to give the pilot a chance. The great hazard in flying is the possibility of losing power on the take-off. Usually there is no place to go. Once altitude is reached there are usually several possibilities for a landing.

Are We Cooperating?—In several of the less thickly inhabited areas of the Clark National Forest in the southeastern Ozark area, wolves have been increasing in number. Local residents have reported serious and continued losses of livestock as a result. Requests for the cooperation of the Forest Service in handling the situation have also increased. In most cases the local residents in asking this cooperation claim, and perhaps justly, that the increase in wolves has been largely in those areas where the woods have not been burned. The cooperation of local residents with the Forest Service in not burning the woods has increased the chances for young wolf cubs to grow to maturity. Therefore, these people believe that it is justifiable to request the Forest Service to do something positive and constructive to control and destroy the wolf packs. Usually these requests are accompanied with the statement that "if the Forest Service can't help us kill the wolves, we will burn the woods next year."

There is considerable justice in this request for cooperation. The Forest Service has asked for, and in many cases is securing, the cooperation of local residents in prevention of the common practice of "burning the woods." What are we doing to help them solve one of the major problems that has arisen as a result of fire prevention? In some cases an effort has been made to have the junior forest guard devote a small portion of his time to killing wolves. In other cases the matter is referred to the United State Biological Survey. The forest guard finds that the limited time he can give to this work does little good. The Biological Survey pleads lack of available funds for hiring men for this work and suggests that the local residents band together and raise funds to hire someone to kill the wolves. This is out of the question, because the residents of these areas do not have the money.

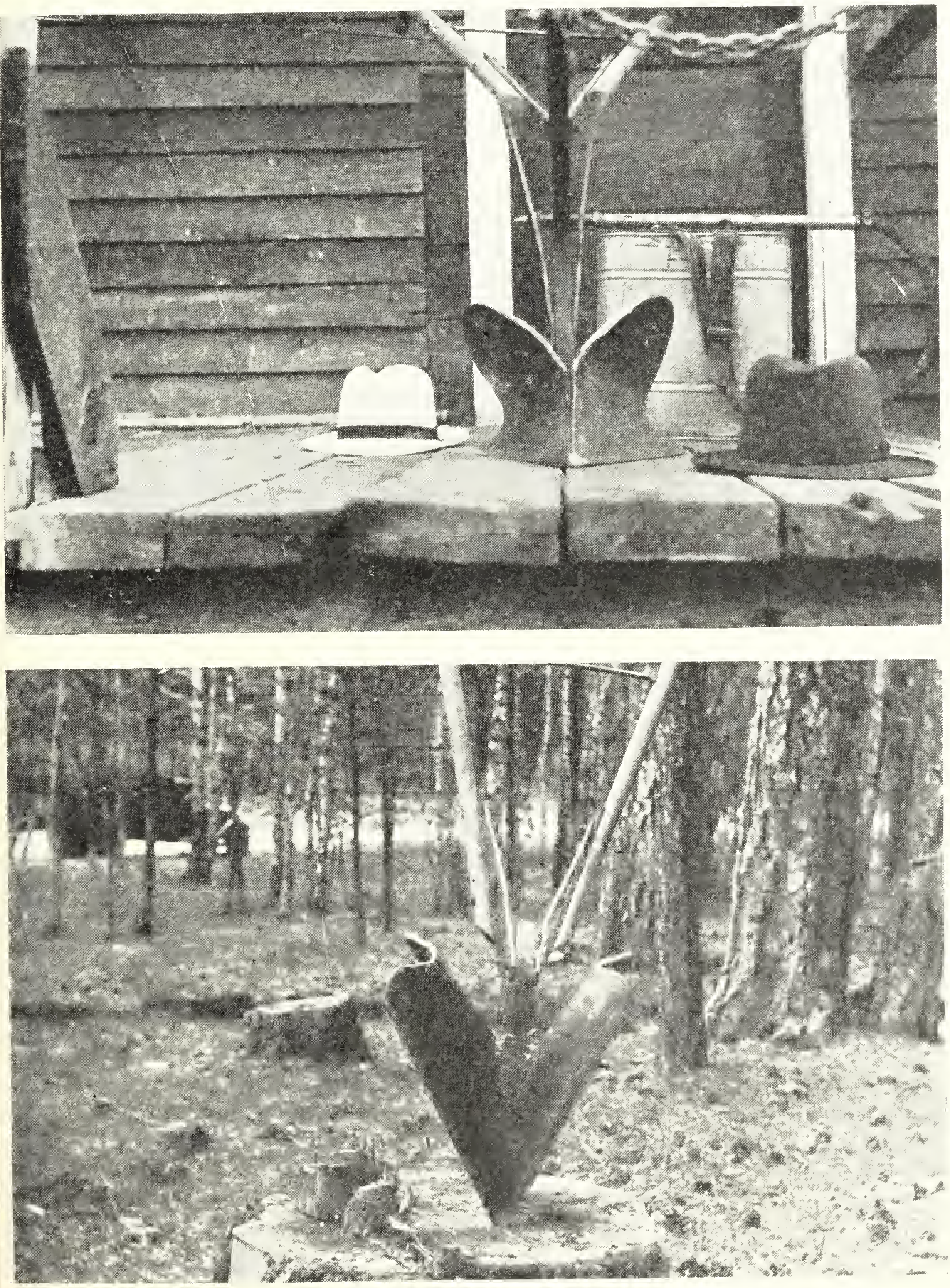
The efforts of the Forest Service up to this time have not convinced the local residents of the forest units that it is doing its utmost to cooperate with them in the elimination of predatory animals. Consequently, should we be surprised if the following season brings a series of woods fires in these areas? What solution is there to offer that will not only prove that the Forest Service wants to cooperate, but also that it will cooperate to the extent of bringing constructive help in those areas where wolves have increased rapidly because the cub litters have not been destroyed by wholesale burning of the woods?—F. S. Wolpert, clerk, Camp F–18, Clark National Forest.

THE HERBERT FIRE PLOW

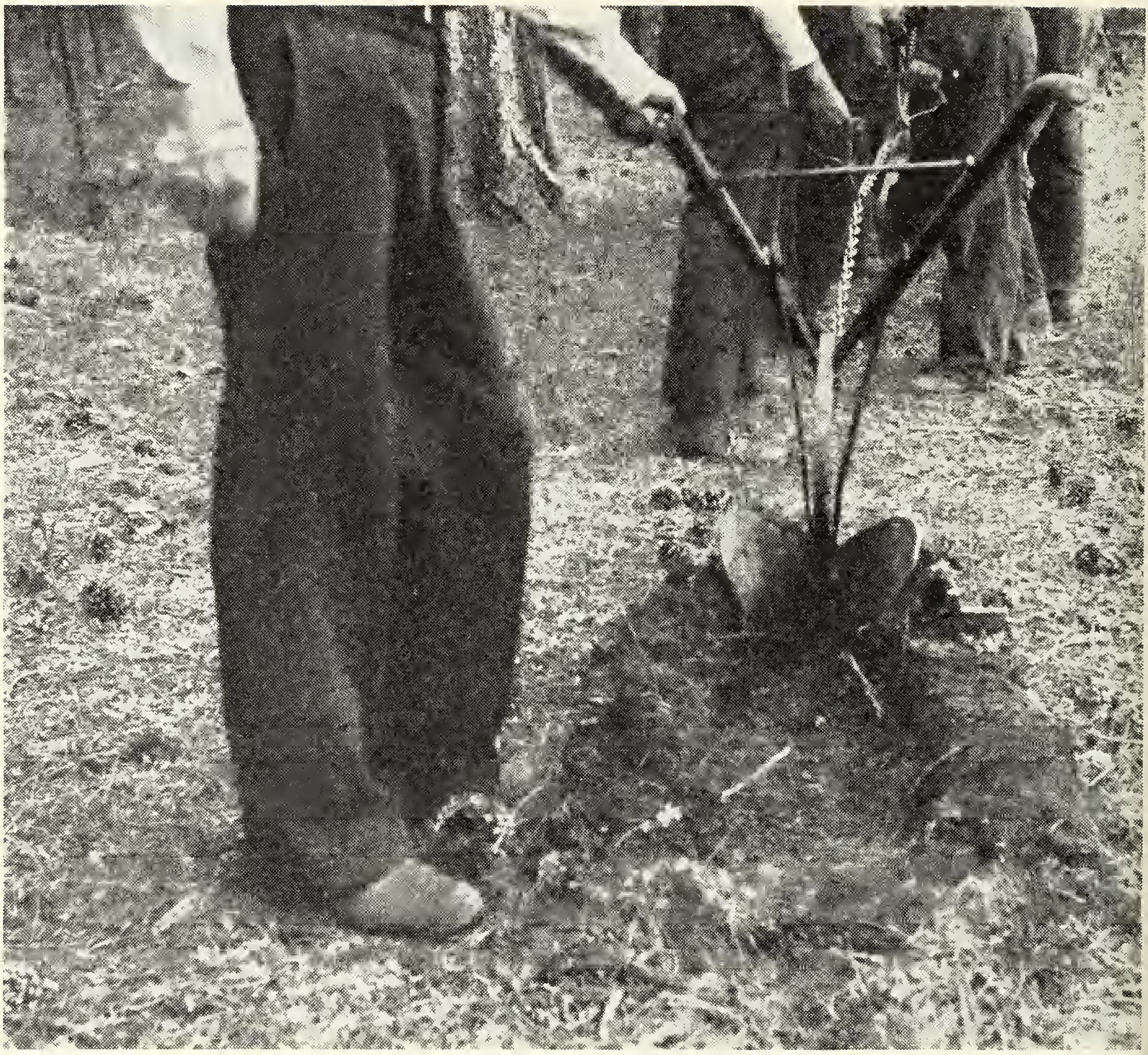
E. A. Snow

Forest Supervisor, Harney National Forest, Region 2, U. S. Forest Service

During the past few years efforts have been made by various nechanically minded individuals in the Forest Service to adapt various machines to the job of building fire line. Plows of various



The Herbert fire plow: Above, front view; below, underside view



The kind of furrow produced by the Herbert fire plow when conditions are favorable.

sizes and shapes have been tried out. Some of them have proved very worth while and are being used extensively at the present time. The greatest drawback in the use of most plows is their excessive weight and the consequent necessity for horse or machine power to operate them.

Early in the spring of 1939, Walter D. Herbert, a construction and maintenance foreman at the Custer F–12 CCC Camp, obtained permission to set up a project for the development of a light plow to be pulled by manpower. He was encouraged to go ahead. With the help of Ralph Smith, another foreman, the necessary materials were assembled (at very little or no cost to the Government) and work was started. Most of the work, of necessity, was done in the evenings or on Saturdays and Sundays. The plow itself was hammered out of 3/8-inch sheet steel, and it was necessary to shape and reshape it several times before it was satisfactory. The plow beam was made out of an old buggy axle. When the plow was finished it weighed 40 pounds, or 55 pounds with drag-chain and hand-holds.

Using 8 or 10 CCC enrollees for power, this plow will make very acceptable fire line at a surprisingly rapid rate of speed. Tests through various types of ground cover, such as grass, needles, kinnikinnick, etc., have produced an average of about 60 chains of line per hour.

The advantages of this sort of plow are:

1. It is light in weight.
2. It can be carried by hand by two men.
3. It can be used with safety any place a man can walk.
4. Neither horses nor mechanical power are required to operate it.
5. It is ideal for the ponderosa-pine type.
6. Both its initial and maintenance costs are low.

It Can't Happen Here—I Wonder.—Let no one deceive himself that catastro-
ic fires are a thing of the past. The conflagrations that all but wiped out
e Presque Isle State Forest in lower Michigan in the spring of 1939 could
ve occurred anywhere under similar conditions. No lives were lost or homes
stroyed because the area in question was practically uninhabited. As it
as, nearly 40,000 acres were burned over and approximately 15,000 acres of
antations destroyed before the fires could be brought under control, in spite
the fact that the area, for the most part, was grid-ironed with fire breaks
d the protection organization functioned with exceptional efficiency.

Starting at 9 a. m. on May 6, the main fire crowned almost at once and, swept
ong by a strong southwest wind, traveled some 15 miles by 5 o'clock that
ght. At its peak, cross shots from lookout towers along the way indicate
at it advanced 3 miles in 40 minutes. This fire was headed that night, but
e following day another fire starting 10 miles to the south, under equally
vere conditions, burned north until it met the main fire. In spite of this
d the fact that a number of other fires of threatening proportions sprang
in the vicinity, all fires were definitely under control by the evening of
ay 8, when a hard rain ended the drought that had prevailed since April
and extinguished what fire remained.

What can be done to prevent such catastrophies in the future is a question.
viously, firebreaks are not the answer nor is it practicable to maintain at
points the organization and equipment necessary to meet such emergencies.
the present instance, it was known that conditions were critical and the
otective organization was on the alert, but not knowing where or when fires
uld occur no mobilization was possible until a fire actually started. The
st fire to start was discovered promptly and a crew of 20 men from a nearby
C camp was on the ground within 20 minutes of the time the fire was
ported. The fire, however, had been set at intervals along a mile front and
s beyond control of the initial attacking force when it arrived. Reenforce-
nts were immediately called for, and in 24 hours more than a thousand men
re on the line and reserve equipment and overhead from as far away as
rquette and Lansing had been brought in. Headquarters was established
the State forest, a radio central set up, portable radio outfits distributed to
rious towers and points on the line, and an observation plane was flown
from Lansing. The fire was driven by a 30-mile wind, however, and direct
tack except on the flanks was impossible until night. Even flank attack was
tremely hazardous because of the intense heat and shifting winds which in
number of cases forced crews to retire to save their lives and equipment.
one time, the State forest headquarters was completely surrounded by fire,
d only heroic efforts on the part of the men there saved the buildings. As
was, the telephone and power line went out, and an emergency crew had
be rushed in from Alpena to restore communication.

The fact that none of the fires, with one minor exception, spread after the
st day and that no men or equipment were lost speaks well for the effective-
ss of the protective organization and the efficiency with which the work
s handled. Even so, the loss sustained is appalling. What it would have
en had organized protection not been in effect can only be guessed. Cer-
nly the area burned would have been much larger and losses proportionately
eater.—J. Alfred Mitchell, Lake States Forest Experiment Station.

COOPERATIVE MEADOW BURNING

A. L. Roe

District Ranger, Superior National Forest, Region 9,
U. S. Forest Service

Each spring the Mesaba District of the Superior National Fore has faced the problem of meadow burning and the carelessness wit which it has been handled. Many of the farmers, when they we all alone, touched off meadows and frequently did not even hav a shovel or any other equipment with which to suppress the fi when the desired area was burned off. The result has necessitate the sending of suppression crews to control the fire after it h broken away and the initiation of law-enforcement cases which a disagreeable and at times result in lessened public cooperation.

It seemed that better public relations could be maintained b assisting the farmers in burning over their meadows safely as we as by preventing additional burned area with the resulting necessit of law-enforcement action.

The problem was discussed with the county agent, and he sug gested the organization of burning rings similar to threshing ring etc. The farmer understands this type of organization and is read to adopt it since he feels that he is actually helping himself.

A "burning ring" was organized in the spring of 1938 at a town ship meeting of Great Scott Township on the Mesaba District. Seve of the farmers present had meadows which they desired to bur over. These men were called together in a separate group and o ganized by selecting one of their members to serve as a forema The foreman's function was to call the group together when one the members desired to burn his meadow and make arrangemen for needed equipment. This system insured the presence of a su pression crew at each burning and lessened the possibility of a fi breaking away. Each member of the ring was repaid for his effor by getting his own meadow burned over safely. The Forest Servi assisted by offering the use of equipment, such as back-pack pum during the burning.

All the meadows in this township were burned over under th system during the spring of 1938 and 1939 a total of 14 burnin without a single break. The system has several advantages whi are of importance to the farmer as well as to the Forest Service:

1. Permits for burning meadows and grass may be issued wi greater confidence.
2. The farmer has protection against the necessity of law e forcement.
3. The contact that a ranger makes in such an organization important since it proves to the farmer that he is interested in t farmer's problems. (The presence of the ranger on at least so of the burnings is well worth while.)
4. The farmer is accomplishing a job which in his mind is absolute necessity and is doing it safely.

In presenting the idea to a group of farmers it is well to emphasi the protection that it gives them.

The ring can also include debris burning on a large scale in co nection with land clearing.

lume 4 Number 2

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A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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The value of this publication will be determined by what Forest Service officers, State forestry workers, and private operators contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire-fighting methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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THE 40-MAN CREW—A REPORT ON THE ACTIVITIES OF THE EXPERIMENTAL 40-MAN FIRE SUPPRESSION CREW

Edward P. Cliff
upervisor, Siskiyou National Forest, Region 6, U. S. Forest Service
and
Rolfe E. Anderson
Leader of the 40-Man Crew, Region 6, U. S. Forest Service

Region 6, throughout the summer season of 1939, conducted an experiment in organizing and operating a special 40-man suppression crew. With regard to this venture in an important field, Regional Forester Lyle F. Watts in his letter of January 9 states:

"The past season's experience has been valuable. All forests are enthusiastic about well organized, trained, and properly equipped mobile crews. Special instructions have been prepared for forests, so they can organize such crews from their own resources. The region is going to spend several thousand dollars for light beds and special equipment. Special overhead training is going to be handled as a project. New ideas in organizing and managing crews on the fire line are being developed and tried out. Reducing overhead costs, particularly behind the line, is almost daily talk on many forests. Costs on walking men to and from camps have been analyzed and discussed. The impetus to these and many other matters has, it is believed, been brought about in part, at least, by the use of the 40-man crew.

"If total expenditure for the 40-man crew, exclusive of the road and bridge construction, is prorated to each mile of fire line constructed, it cost $871 per mile. Long distance transportation, camp construction, etc., are all included. If only fire equipment, training, transportation, and suppression costs are included, the crew constructed each mile of fire line for $325. By comparison, it cost an average of $1,991 to construct and work each mile of 229 miles of fire line on six of our largest fires. If one-third of this was expended for mop-up and thus eliminated, the 40-man crew constructed line 35 percent cheaper, if all its costs are included; or over four times cheaper if only its fire costs are included, as compared to ordinary crews. Such a rough comparison does not tell the whole story as the 40-man crew in every case worked on the most inaccessible and difficult sections on fires, and time and expense of transportation were unusually high because of long distances traveled."

Mr. Watts' letter transmitted the comprehensive illustrated and charted report on the project. In addition to this detailed report, Messrs. Cliff and Anderson have prepared for publication in Fire Control Notes a most interesting condensed version.

Fire control men have realized for several years that the practice o recruiting untrained fire fighters for the suppression of large fires hs proved inefficient and expensive. The 40-man fire suppression cew was organized in an effort to overcome apparent weaknesses in tis important phase of forest management. Plans originating in Rgion 6 and the Washington office called for the organization, on a experimental basis, of a carefully selected, highly trained 40-man fie suppression crew equipped to sustain themselves for periods of at lest 3 days in inaccessible back country where the work of ordinary crews is inefficient. Each member of this crew was to be selecte for his physical prowess and woodsmanship, hardened by work, an trained to use the correct technique in handling each foot of fire lin without detailed supervision.

The Redwood Ranger Station on the Siskiyou National Forest wa selected as the best location for the crew. This station was on th Redwood Highway, facilitating fast travel by paved routes to fores areas along the coast and Pacific highways, and forests east of th Cascade Range. In addition, this headquarters site was in the immediate proximity of needed project work, which would help financ the crew, and was located on a forest with large inaccessible area and difficult fire problems.

Preparation and Training

Recruiting.—A junior forester with 10 seasons' experience i supervisory work on fires was chosen as leader. In an effort t choose qualified men for the crew in a limited time, the regional office requested each forest to submit the names of several qualifie candidates. The crew members were selected from these candidate by the leader immediately after his assignment to the job. Most o the crew members reported for duty between June 16 and July 1 and the crew reached full strength by July 9. Eight additional me were recruited throughout the ensuing season to replace men found to be unqualified because of poor health, poor workmanship, and other deficiencies.

Four squad bosses were selected who were well qualified in the instruction and management of small crews on fires, in camp, and o work projects. In picking other members of the crew, men wer selected who were not only capable fire fighters, but who also had specialties in other lines of work. The crew included 2 qualified first-aid men, 2 "cat skinners," one grader man, 10 fallers, and 3 me capable of doing fire line cooking. A professional cook and 2 flunkie were hired to prepare all meals for the crew while in camp. Th leader and squad bosses were included as part of the total crew o 40 men. The kitchen force was in addition to the regular 40 me of the crew. Since the work of this crew was largely experimenta in nature, a special recorder was added to insure obtaining necessary detailed records of the activities and accomplishments of th crew.

Salaries and Civil Service Status.—Members of the crew wer hired as guards (CU–4) pending certification of eligibles, at a entrance salary of $110 per month. The squad bosses were given CU–5 rating, with a salary of $125 per month. When away fro Grants Pass. the crew members were supplied board and lodging b the Government.

Camp Site and Quarters.—A camp site was selected one-fourt mile from Redwood Ranger Station on the bank of the Illinois River Eleven tents set up on tent frames provided comfortable living quarters for the crew. Two portable wooden buildings were constructe for use as a mess hall and bathhouse. A third portable building loaned by the Siskiyou National Forest, was erected for use as a stud hall, conference room, and office quarters.

Water was distributed to all parts of the camp by a pipe lin tapping the ranger station water system. Electricity for camp light

g was purchased from a commercial power distributor. A grounded
lephone line, 800 feet of road, and a 20-foot bridge were constructed
y the crew to provide communication and access to the camp.

A number of recreational facilities were provided to occupy the
isure time of the men closely confined to camp. A gravel dam was
rown up across the river to form a small lake for swimming. A
ft-ball diamond and volley-ball and horseshoe courts were cleared
d leveled for the enjoyment and conditioning of the men.

The cost of constructing and maintaining the camp and supplying
el amounted to $6,245, which includes the value of the time devoted
the 40-man crew to these activities.

Equipment and Supplies.—The objective in equipping the 40-man
ew was to select tools, bedding, and rations which would convert
e crew into an effective fire-fighting unit, self-sustained for a mini-
um period of 72 hours, and which at the same time could be carried
er trails and rough country at a creditable speed without unduly
ing the men. This objective was met by building up packs which
cluded essential fire tools, concentrated rations consisting mainly of
hydrated food, and lightweight, goose-down sleeping bags which
lled into bundles 13 inches long and 7 inches in diameter. These
mpact bags, well tailored, with zipper on both inner bag and cover,
oved sufficiently warm for summer use.

Table 1 shows the content and weight of an average pack with
ential equipment. The complete list of fire tools carried to and
ed on all fires upon which the 40-man crew took action is shown in
ble 2.

Contents of 40-man pack.

TABLE 1.—*Contents of an average 40-man-crew pack*

Number	Item	Weight in pounds
1	Pack board, Trapper Nelson	5½
1	Headlight w/3 extra batteries	1½
1	Canteen w/water (to hang on belt)	2½
1	Sleeping bag, lightweight	5½
2	Lunches in cloth sack (to hang on belt)	1½
1	Rations, 3 days	11
	Cook and mess outfit or extra equipment	2
	Personal effects	2
	Tool, fire (average weight)	4
	Average weight per man, total	35½

TABLE 2.—*Fire tools carried to and used on fires by the 40-man crew*

Number	Item	Weight in pounds (each)
4	Axes, cruiser's	2½
6	Axes, swamping	3½
10	Pulaskis	3½
10	Hoes, hazel	3½
10	Shovels, baby (6 carried by last 6 hoe men)	2
12	Fusees (for burning out)	½
2	Saws, falling, w/handles	10
1	Back-pack bag, w/pump	6½
4	Axes, falling	4
2	Oil cans, 1-pint	1
4	Wedges, wooden	½
10	Axestones, carborundum	½
10	Files, 10-inch	¼
4	Bags, water, 2½-gallon	½
1	Bag, water, 5-gallon	1

Surplus saws, axes, steel wedges, sledges, hoes, and shovels were always carried on the fire truck for use in case the regular tools were not sufficient. During the season no use was made of this extra equipment except in the exchange of dull tools for sharp ones.

Equipment used by this crew and found to be especially adaptable included hardwood wedges which can be driven with the side of an ax, and fusees for backfiring. Fusees were particularly adaptable for this crew because of their lightweight, which made it possible to carry enough to enable several men to backfire at one time.

Special equipment such as radio, compasses, and first-aid kits was used by the crew on all fires.

Various kinds of concentrated food were tried by the 40-man crew on the fire line. Table 3 lists items of food by weight and calorie content which proved to be the most satisfactory combination. It is felt that through further study, however, it might be possible to devise a lighter ration with equal nutritive value.

On going to a fire each man carried two lunches on his belt so that no time would be lost in preparing meals during the first shift on the fire line.

Table 3.—*Ration list, 1 man 3 days*

Item	Weight in pounds	Calorie content	Where to obtain
Eggs, powdered	½	1, 330	Eddie Bauer, 2d and Seneca Sts., Seattle, Wash., or Sports Craft Inc., 512 Southeast Yamhill St., Portland, Oreg.
Cervelot	1	1, 800	Nearly all grocers.
Bacon, canned	1	2, 600	Do.
Soup concentrate	½	2, 500	Eddie Bauer, 2d and Seneca Sts., Seattle, Wash.
Potatoes, dehydrated	½	1, 800	Do.
Rice, white	1	1, 600	Any grocer.
Apple concentrate	½	1, 500	Columbia Fruit Processors, Inc., Pateros, Wash.
Sugar	½	900	Any grocer.
Tomato juice	½	100	Do.
Hardtack	1	1, 600	Do.
Coffee	¼	--------	Do.
Lemon drops	½	850	Any confectionery.
Anchovy paste	⅛	600	Any grocer.
Dates	1	1, 600	Do.
Figs	1	1, 400	Do.
Salt	⅛	--------	Do.
Butter, canned	½	3, 500	Order through grocer.
Milk, powdered	½	2, 300	Any grocer.
Total	11	25, 980	

ccording to dietitians, hard manual labor requires 3 calories per nd per hour. A 180-pound man working and/or hiking 16 hours day for 3 days requires 25,920 calories. Therefore, the ration d in table 3 is ample, and the 2 lunches carried by the men on first shift offer a large margin of safety.

ased on the experience of 1939, it is advisable for the leader of crew to make out a basic menu with a choice of substitutes of ut equal weight and calorie content. The men may be allowed hoose any substitute listed in table 4. This will assure a balanced d ration. It was found that a free individual choice usually does result in a balanced menu.

Table 4.—*Desirable substitutes for 40-man-crew ration*

Item	Weight	Substitute for—	Where to obtain
Dried beef		Cervelot	Any meat market.
Lemon juice	12 ounces	Tomato juice	Any grocer.
Grapefruit juice	do	do	Do.
Raisins	do	Dates	Do.
Cheese, dried	8 ounces	Anchovy paste	Do.
Peaches, dried	1 pound	Figs	Do.
Apricots, dried	do	do	Do.
Spaghetti	2 pounds	Rice	Do.
Oatmeal	do	do	Do.

Cooking on the fire line.

Transportation.—Three 1939 model, 1½-ton Chevrolet truck were used for transportation of crew, supplies, and equipment t and from most of the fires and on work projects. Two of thes trucks were equipped with comfortable, upholstered seats for haulin the men, and one was used for supplies and fire packs.

On the longer and more tiring trips such as the 360-mile trip t the Big Cow Creek fire on the Malheur and Whitman National Forests, commercial busses were used. These busses added greatly t the comfort of the men and made it possible for them to rest en route and arrive on the fire in better condition than if they had travele by truck.

Personnel Management.—Some restrictions were required i order to keep the men constantly within fire call. Camp rules wer established, outlining the responsibilities of the crew members as t fire duty, fire calls, camp police duties, and personal conduct an appearance. Only a few instances of infringement of these rule occurred during the season. Tension of stand-by duty was lessene considerably by frequent fire suppression jobs.

Opportunity was given each member of the crew to leave cam periodically to purchase tobacco and other personal effects and t attend the local theater once or twice weekly, provided they signed out and agreed to stay in a group going to and returning from th theater. Excursion trips were made under the same arrangement

Softball and volleyball teams were organized, and weekly games vith Cave Junction and the Oregon Caves CCC Camp were played hrough the early part of the summer. Swimming, horseshoe pitchng, and punching-bag work-outs also absorbed no small amount of urplus energy. Some leisure time was devoted to study of the handooks, bulletins, and periodicals contained in the 40-man-crew lirary. Leisure time classes in first-aid, lifesaving, and safety were onducted by qualified crew members.

Because of the seriousness of the fire season and the shortage of anpower caused by sickness and injury, only a small amount of nnual leave was given during the main part of the fire season. wo more men were added to the crew during the latter part of he season so that accumulated leave could be granted and still mainain the crew strength at 40 men.

Fire Training.—Fire training was started June 20, immediately fter the first large influx of recruits. Frequent training sessions ontinued up to July 21, when the crew was called on the first fire. n occasional training period was given subsequently for the benefit f new recruits.

In the first training periods emphasis was placed on fire line rganization and construction so that the crew would be in readiness r immediate call. Training continued with practice hikes and rills in unloading fire packs from trucks and reloading them again that a certain speed and precision was acquired in performing ese routine jobs. Conferences were held on methods of line conruction, fire behavior, and fire strategy in various fuel types, in njunction with the field training sessions.

Special training was given selected crew members in radio operaon, fuel type mapping, and first aid by qualified instructors.

Work Projects.—Two work projects, located 9 miles from camp, ere selected to utilize the time and energy of the crew members hen they were not occupied with training or fire fighting or engaged camp construction activities. The purpose was threefold—namely, keep the men in good physical condition, to help finance the crew, d to accomplish useful and needed work. The construction of e Illinois River Bridge and the Eight Dollar Mountain Road were e two projects selected. The bridge was a creosoted wood, Howe uss structure, with a main span of 137½ feet and an approach on e end of 52 feet. This bridge was completed by the crew in the ll of 1939. A total of 815 man-days was spent on the project.

The crew spent a total of 672 man-days on the Eight Dollar Mounin Road and brought a 2-mile section to about 75 percent of mpletion.

Action on Fires

The 40-man crew worked on 8 class C or larger fires located on national forests in Region 6 between July 21 and September 2, 39. The two periods worked by this crew on the Saddle Mounin fire were counted as two fires since they were analyzed separately d were widely divergent in location and time. The fires on which e 40-man crew worked and the time and travel chargeable to these es are listed in table 5.

TABLE 5.—*Fires worked upon by the 40-man crew in 1939*

No.	Name of fire	Forest	Dates	Days on fire (including travel)	Miles traveled (truck or bus)
1	Horseshoe Bend	Siskiyou	July 21 to July 26	5½	80
2	Blue River	Willamette	July 27 to July 28	2	421
3	Wheeler Creek	Siskiyou	August 7 to August 8	2	150
4	Saddle Mountain (east side).	Siuslaw	August 10 to August 13	4	300
5	Willard	Columbia	August 14 to August 17	4	543
6	Eagle Creek	Siskiyou	August 18 to August 21	4	127
7	Saddle Mountain (west side).	Siuslaw	August 22 to August 26	6	663
8	Big Cow Creek	Whitman	August 28 to September 2	6	725
	Total			33½	3,009

Get-Away Action.—Get-away time on fires varied from 31 to 75 minutes, according to circumstances at the time of the call. The crew was dispatched from their headquarters camp on four occasions. Three of these calls came in the late afternoon before supper and the fourth immediately after breakfast. On two occasions the crew was working on the road project 9 miles away, and it was necessary to assemble them at camp before leaving.

If the call came near mealtime and the meal was practically prepared, the men were usually fed before leaving. Assembling and feeding the men resulted in rather slow get-away time on several occasions. However, it is believed that the practice of feeding the men before leaving is justified, particularly if a long trip of several hundred miles is involved, because it avoids making a meal stop en route and the men arrive in better condition than if they travel without food.

Experience in 1939 brought out that the following considerations should govern action looking toward faster get-away time:

1. Keep all members of crew in direct telephone communication at all times. Use large extension bells, sirens, and other signals where necessary.
2. Order lunches or prepared meals ahead on route of travel if time can be saved in this way.
3. If dinner is prepared at camp at the time of the call, the crew should be allowed to eat before leaving in order to avoid losing time en route.

Meals and Stops En Route.—One or more meals were usually eaten en route to the more distant fires. In all but a few cases, a dependable restaurant was notified by phone in advance and no time was lost in the preparation of the meals.

Time Distribution on Fires.—Table 6 shows the distribution of fire time for the 40-man crew, based on data recorded on the eight fires upon which the crew worked. These computations include time from start of work to completion of control line on all fires or sectors of fires handled by the crew.

40-man crew hiking to a fire.

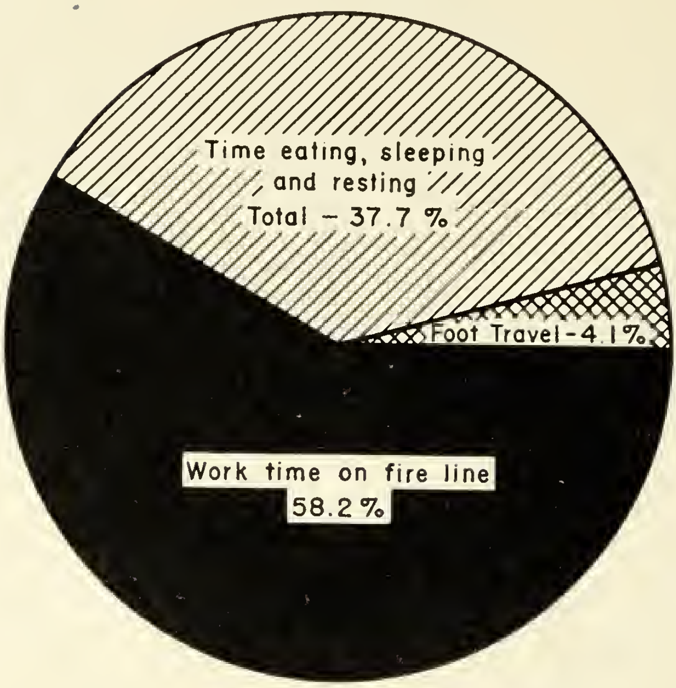
TABLE 6.—*Time distribution of 40-man crew on fires*

Time element	Total hours	Percent of time
oot travel	12. 31	4. 1
orktime on fire line	176. 58	58. 2
ime eating, sleeping, and resting	114. 36	37. 7
Total	303. 25	100. 0

Distribution of time as recorded above is shown graphically in
ie chart on page 56.

No comparable figures are available for other crews, but it is be-
eved that this table shows plainly the advantages of using self-
istaining crews on inaccessible sectors of fires. Foot travel to and
om such sectors by ordinary crews serviced in established base or
ne camps usually consumes a great deal more than 4 percent of the
me of fire fighters and saps a tremendous amount of energy of men
ho are unaccustomed to hiking in rough country. The usual prac-
ce of camping on or near the fire line wherever night overtook the
ew insured the effective use of a large proportion of the day with a
inimum of lost motion. Truck- and foot-travel time to the fires
om the time the crew was dispatched up to the point control action
as started is not included in these figures. However, when de-
rmining the distance practicable to dispatch such a crew, it should
considered that more than one-quarter of the total time charged to
es was consumed in travel by truck and on foot to the fires.

TIME DISTRIBUTION CHART



Organization and Method Used in Line Construction.—A progressive method of line construction, which in reality is a variation of the one-lick method, was used successfully by the 40-man crew on all fire suppression work.

The progressive method used has the advantages of the one-lick method; namely, the elimination of lost time occasioned by men passing each other in the line and the enthusiasm and unity of effort generated by rapid and continuous progress. It is superior to the one-lick method in that men can do more effective work by taking a stance and completing a unit of work and each man can be held accountable for a given segment of line. The form of organization is illustrated in the diagram on page 57.

A description of the organization of the men on the line and their duties under the progressive system follows:

1. A scout from the crew was used when no outside scout was provided. When not scouting, this man worked as an axman.

2. The line locator selected the location and blazed the way. He was directed from time to time by the crew leader as information was received from the scout or direct observations of the fire were made.

3. Nine axmen, using three cruiser's axes and six 3½-pound swamping axes, followed the locator. Ordinarily the ax crew did from 50 to 100 percent of the clearing, depending on the relative amount of clearing to be done as compared with digging and holding.

4. Ten pulaski men worked behind the axmen and cleared or dug line as the needs justified. The pulaski men hold a unique and vital position on the line. By using the cutting edge of the tool for clearing they may speed the clearing and slow the hoe work, and by turning over the same tool the opposite effect can be accomplished. The versatility of the pulaski men enabled the crew to adapt itself to a great variety of cover types without changing the line-up of tools.

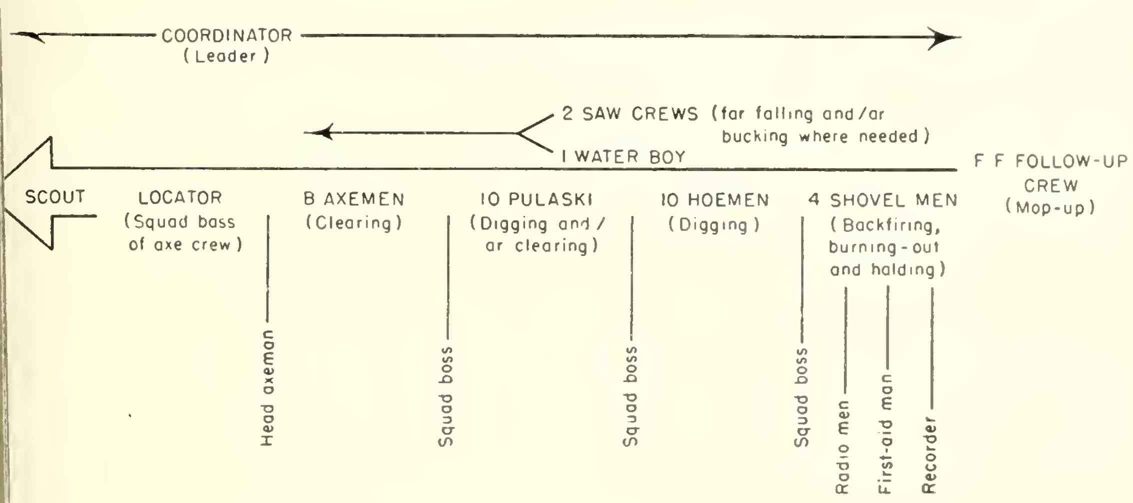
5. Ten hoe men followed the pulaski men and completed the line
gging. In favorable types one or more Kortich tools were substi-
ted for hoes. Six of the hoe men carried extra shovels to the point
attack so as to have them when needed to assist in holding and
opping up the line. These extra shovels were called into action
almost every fire in order to take care of the emergency "break-
ers" and spot fires which the usual shovel crew could not handle.
ter arrival on the fire, the spare shovels were carried by the shovel
n in an extra pack sack with the fusees and other miscellaneous
ms. By following this practice, the hoe men were not burdened
th an extra tool while working.

6. Four regular shovel men were on hand at all times to do the
rning-out and holding the line behind the line construction men.

7. Two sets of fallers equipped with falling tools worked as and
here needed for falling or bucking. They were usually directed
the coordinator.

DIAGRAM OF PROGRESSIVE METHOD OF LINE CONSTRUCTION

USED BY THE 40-MAN CREW


COORDINATOR
(Leader)
2 SAW CREWS (for falling and/or bucking where needed)
I WATER BOY
F F FOLLOW-UP CREW (Mop-up)
SCOUT
LOCATOR (Squad boss of axe crew)
8 AXEMEN (Clearing)
10 PULASKI (Digging and/or clearing)
10 HOEMEN (Digging)
4 SHOVEL MEN (Backfiring, burning-out and holding)
Head axeman
Squad boss
Squad boss
Squad boss
Radio men
First-aid man
Recorder

. One man was always used to carry water, and two were so
ployed when needed.

he crew leader controlled the movement of the squads in such a
y as to effect the highest rate of held-line production. A qualified
ad boss was used as a line locator. When not engaged in locating
was in charge of the ax crew. Where considered of vital impor-
ce the leader did his own locating. The second squad boss was in
rge of the pulaski crew. It was his responsibility to keep a bal-
e of work between clearing and digging by shifting his men from
operation to the other as the needs arose. The third squad boss
in charge of the hoe crew. It was his function to complete the
and cooperate with the burning-out and holding crew, dropping
from his crew to the holding crew when needed. The fourth
d boss supervised the burning out and holding of the completed
until it was taken over by the follow-up crew.

umbering of Men and Packs.—Each man of the crew was given
mber, according to his place in the line and, except for a few
nges, each man kept this number throughout the summer. Each
pack was also numbered from 1 to 40, corresponding to the
nber of the man carrying the pack.

Building fire line.

Unloading from the trucks and hiking to the fire front was done in sequence of numbers. Upon returning from the fire the packs were placed in the truck in reverse order from which they were taken out—that is, number 40 pack was the first to be loaded. This system of unloading and loading made for speed and precision. A quick deployment of men in working positions was facilitated by arriving at the point of attack in regular formation.

Foot Travel.—Upon reaching the end of motor transportation, each man received his pack and the crew was led over trail or rough country in single file formation to the point of attack. Rest stops were made during hikes as needed. Average rate of foot travel was computed at 2.5 miles per hour, including rest stops of less than 30 minutes.

Deployment of the Crew on Fire.—Upon arrival on the fire, a quick size-up was made and, if necessary, the 40-man crew scout was sent out to look over the country immediately ahead. Scouting was usually done by scouts not attached to the 40-man crew. If the entire crew worked as one unit, they fell to work in line in the regular unloading and hiking order. If the crew was split into two units, as was occasionally done, the even-numbered men went one way and the odds another. This resulted in the even division of both men and tools. Unless the direct method was used, the burning-out crew followed and kept apace, but at a short distance behind the hoe crew. If a follow-up crew was worked immediately behind, the burning-out crew was usually able to keep up without dditional help. If adequate follow-up was not provided, however, became necessary to drop more and more men from line construcon work to burning out and holding.

The practice of splitting the crew into two or three work units orked out very satisfactorily on spot fires and in cover having low medium resistance-to-control factors. The gain in splitting of ews, of course, is brought about by a saving in total time devoted walking. In high resistance-to-control types, however, the relave saving in walking time is much reduced, and it is believed the lvantage is negligible in an extreme resistance-to-control type. nother advantage of a split crew is that work can often begin the head of a fire, and one unit can work each way to effect a ster control.

The greatest disadvantage in the division of the unit was the fficulty of giving adequate supervision. This disadvantage can overcome by careful training of overhead. In the heavy restance-to-control types found on three fires in 1939 the crew worked greatest advantage as one unit.

Packing on the Fire Line.—An ever-existing problem was that of eping the fire packs up with the men. This problem was solved using a variety of methods as follows:

1. By intersecting the fire at a central point so that the crew can ork both ways from the starting point. Upon arrival at a fire was often possible to predict where the crew would stop work at e end of the shift and drop the packs there.
2. By leaving packs at the point where work began and returning er them when an opportunity permitted.
3. By delegating the burning-out crew to take charge of moving packs forward as the line progressed.
4. By delegating an FF or CCC crew to carry packs ahead from ne to time. Horse packing was not feasible on account of the ccessibility of the country in which the 40-man crew worked. orses were utilized but once during the season.

Follow-Up.—One of the biggest problems which confronted the man crew was securing adequate follow-up action. Almost every est on which the crew worked showed a readiness to cooperate by ding ample follow-up behind the 40-man crew. The failures ually arose from not making certain that the men arrived when d where they were needed. For example, on one fire a night crew s sent out, but they were poorly guided and did not arrive. On other fire they worked on a "cold" line to the neglect of a mile of ot" line. In each instance it was necessary for the 40-man crew put in a double shift in order to prevent the loss of line they had nstructed. It is recognized that the ordinary follow-up crew king in from a central camp each day, is under a tremendous ndicap. After the second or third day behind the 40-man crew, follow-up crew spends more and more time walking to and from rk, which progressively reduces the amount of time and energy ilable for effective action on the line. The solution to this oblem apparently lies in equipping the follow-up crew with light eping bags and condensed rations so that they too can stay out the line.

Cover Types.—Several cover types were encountered by the 40-man crew, including high and low brush, Douglas fir timber, lodgepole deadenings, and ponderosa pine types and snag areas. The progressive method of line construction, with slight variations, worked well in all these types, and the crew proved to be a versatile unit and readily adapted itself to the various conditions encountered. The tools carried by the crew adequately met the needs in all types encountered. The pulaski tools are the "balance wheels" which made it possible to work efficiently in the various types with the same equipment. Experience during 1939 indicates that a trained crew of 40 men is about the proper size for work in moderate and high resistance-to-control types such as are encountered over most of the Douglas fir region, and that smaller units of about 20 men will work more efficiently in the low resistance-to-control cover which is characteristic of ponderosa pine forests.

Accomplishments

A careful record was made of the action of the crew and rate of line construction on each fire. At the completion of the fire season a detailed review was made of each fire by the leader of the crew. Space will not allow these records or reviews to be presented here. By way of summary, however, two measurements of the efficiency of the crew are given by comparing its rate of held-line production with the Region 6 standards and with average production of other crews on large fires in this region.

The comparison of rate of line construction by the 40-man crew with the Region 6 standard was made by computing the length of time that it would take to build under regional standards the same line as was constructed by the 40-man crew on the various fires. In making these computations due weight was given to the proportion or length of line on each fire in the different resistance-to-control classes. Complete data for this comparison were taken on six fires and are summarized in table 7.

TABLE 7.—*Held line production, 40-man crew 1939, compared to Region 6 standard*

Name of fire [1]	Resistance to control rating			Total line worked		40-man production held line per man-hour chains	Region 6 standard same held line per man-hour chains
	Chains						
	Low	Medium	High	Chains [2]	Hours		
1. Horseshoe Bend	51	42	19	112	67. 4	1. 66	0. 53
2. Wheeler Creek	15	25	22	62	46. 5	1. 33	. 45
3. Saddle Mountain (east side)	55	30	9	94	87. 1	1. 08	. 62
4. Willard	32	20	7	59	42. 5	1. 39	. 56
5. Eagle Creek	40	124	63	227	319. 8	. 72	. 42
6. Big Cow Creek	97	39	4	140	100. 5	1. 39	. 73
Total or average	290	280	124	694	663. 8	1. 04	. 51

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[1] Accurate data were available only on 6 fires.

[2] This figure includes only length of recorded held line. About ⅓ of held line built was recorded and given resistance-to-control ratings. A total of 28 miles of control line was worked in 1939, in addition to a large amount of unmeasured work on spot fires.

The comparison of the accomplishments of the 40-man crew with other crews shows that throughout the season it attained an average rate of held-line production of 0.34 chains per man-hour as compared with 0.07 chains per man-hour for large crews working in Region 6 on fires 300 acres or larger from 1936 to 1938, inclusive. The data for these large crews were taken from the July 1939 issue of Fire Control Notes. It may be noted that the rate of line production in this second comparison is less than that shown in table 7. This is accounted for by the fact that burning out, holding, and mop-up, as well as travel time while on a fire or sector of a fire, were included when computing this average in order to make the 0-man crew rates comparable to those listed in Fire Control Notes.

These figures show that the 40-man crew produced line at twice he speed set up by Region 6 standards and about five times the rate produced by other crews on all large fires in Region 6 over the last years. Even so, these figures do not give a true picture of the fficiency of the 40-man crew in comparison with other crews because f the following factors:

1. In the first comparison the regional standards are based on small s well as large fires, and accomplishments on small fires are usually greater than on fires of the size acted upon by the 40-man crew.

2. The 40-man unit was in most cases dispatched to the most ugged and remote sectors of the fires in which the fatigue factor f travel is more pronounced than for crews working near the road.

3. The 40-man unit was sometimes used as "pinch hitters" on sectors difficult for other crews to hold. On these sectors the 40-man rew was valuable chiefly as a holding crew and line production was secondary factor. After hours of difficult holding under heavy moke conditions, the crew was in poor condition for high production n the line.

Weak Points

The 40-man crew was organized and trained as a line-building rew. Plans were made for the 40-man crew to burn out and hold heir own line for about 2 hours after construction, after which time he line would be taken over by an FF or CCC crew. The men were old that they would be expected to work at a fast rate of speed or a definite shift of 8 to 10 hours and that mop-up and holding ould be taken over by another crew. To work a longer shift would efinitely call for a slower pace.

As it actually worked on many of the fires, the men walked long istances, then worked on line construction at a fast pace for 8 to 0 hours; but instead of being relieved it was necessary for the crew o do their own mop-up and patrol for long periods after the line as constructed. This worked the men excessively long hours. In ne case the crew was engaged more than 20 hours in continuous ork and travel with only short intervals of rest. It is not physically ossible to continue at a fast pace for such long periods, and the en will consciously slow their pace to avoid complete fatigue.

The ultimate results of this practice, if continued, will be to slow own the rate of line production. The men will expect to stay out n the line for excessive hours and will work at a speed commensurate with those hours in order to sustain themselves throughout the day. In working excessive hours day after day, we have lost sight of that part of our objective of maintaining a fire-fighting crew capable of working at unprecedented speed to stop the first run of fire, burn out the line, and turn the mop-up over to a relief crew.

Costs

A total allotment of $35,090 was set up to the forest to finance the 40-man crew from the time of recruiting to the end of the fiscal year 1940. This allotment was planned to cover all costs of camp construction, subsistence, transportation, and wages throughout the work season, including fire suppression and project work. It was planned that a contingent of $7,000 should be carried over to finance the crew in the spring of 1940.

Actual expenditures for the crew through the season of 1939 totaled $30,914. Of this amount $2,642 was spent on overhead and $5,491 was used for the subsistence of the crew. The entire cost of camp construction and maintenance totaled $6,245, and fire training was recorded at $1,082. The contribution to fire suppression work by the 40-man crew amounted to $6,742. All other cost, including labor, cost of transportation to and from work on the bridge and road projects, and other miscellaneous items of cost, totaled $8,712. The work of the crew on these two projects was appraised at $5,000 at the close of the season.

The balance in the available allotment, plus the unexpended F. R. D. earnings, amounts to $9,176, which will be available to pay the salary of the leader during the balance of the present fiscal year and finance the crew for approximately 2 months next spring.

Conclusions

It is felt that the 40-man crew experiment was successful in achieving the purpose for which it was conceived. The careful selection and methodical training of personnel and the choice of lightweight equipment, including concentrated rations, featherweight beds, and up-to-date fire tools, combined to make a sturdy fire-fighting unit of great mobility, which was able to sustain itself in inaccessible country for periods of 72 hours or more and take effective independent action on the most remote sectors of a fire. The merits of this form of organization are obviously shown in the records of rate of line construction contained herein.

It is believed that this system can be applied to other crews organized from picked CCC enrollees and the personnel of construction crews. Units so organized will probably not measure up to the 40-man crew in physical development, but would have the advantages of mobility and self-reliance made possible by the use of lightweight beds, concentrated rations, and a judicious balance of tools.

It is also believed that the special equipment can be used to advantage by crews of untrained pick-up laborers by enabling them to stay out on the fire line, thus reducing the large expenditure of time and energy used in walking to and from established camps and curtailing the expense of servicing fire fighters in inaccessible country.

LESSONS OF THE McVEY FIRE, BLACK HILLS NATIONAL FOREST

A. A. Brown
Fire Control, Region 2, U. S. Forest Service

Making a pretty complete kill on 22,000 acres of highly productive country, where every cubic foot of timber that can be grown is needed to sustain the dependent communities, the McVey fire was easily the worst fire of the 1939 year. To find and follow through the clues leading to increasing mastery of such fires offers the sharpest possible challenge to fire-control students. Such losses are intolerable, but it will take more than our usual insight and methods of study to find out why they occur. When we find the answers, it will take more than our usual forms of training to get the essential principles of control so embedded in the minds of enough men that these principles will be applied in future crises.

At 11 p. m., 9 hours after the arrival of the first 68 men on the fire, those in charge recognized for the first time that they "were up against a fire that wouldn't act according to rule." The fire had spread less than 250 acres in the previous 5 hours and had reached a total of approximately 1,600 acres. Wind from 7 to 10 p. m. had been "nearly imperceptible." Completion of the control line in the early morning hours "appeared certain" long before the time required by the first work-period policy. But about 11 p. m. the wind freshened a little and the fire marched out through the unworked gap of "less than half a mile" and started a spread which was not corralled until 34 hours later. The surge of the fire at about 11 p. m. the first day was the result of recognizable causes or it was not. Can we discover why this and similar fires behave the way they did? Whether, like a rattler, they actually gave a warning which we might learn to recognize in future before it is too late?

The data submitted by Staff Technician Skinner shows that at 6 p. m. on the first day, 5½ hours after discovery and 4 hours and 40 minutes after arrival of the first cooperator crew, the fire had a perimeter of 10.2 miles (including a 25 percent addition to a machine count of map miles). Of this total, 4.6 miles were in the same location as when the fire was finally corralled—mostly on or close to roads, fields, and prairies; and 2.3 miles were held until 9 a. m. the next morning. The spread from 6 p. m. of the first day to 9 a. m. of the second day came, therefore, from not over 3.3 miles of front as of 6 p. m. on the first day. The author's figure of 10 miles to build as of 6 p. m. evidently considers expected spread after that time, but does not include the 6.9 miles of line or edge as of 6 p. m. which was in the same place at 9 a. m. the next morning.

Output of held line up to the completion of the final control line was 0.1 chain per man-hour—which again falls within our semistandard of 0.06 to 0.16 of a chain per man-hour. No figure is available on lost line. Spotting was naturally very bad. Can't we develop better ideas for dealing with spot fires? As a simple example, how can we get men to watch and comb the places where spot fires may start instead of watching the fire from which the sparks come? Sounds easy, doesn't it?

Before the first crew arrived, two post cutters working nearby saw and tried to stop this fire. They failed and had difficulty in escaping. They were suspected of starting the fire, but it was later proved to be a hang-over lightning fire.

The heading under which this must be written, and its implied purpose, impose an automatic censorship on its contents. A lesson in fire control to be of interregional interest should introduce something new, or should at least give new emphasis to principles or to aspects of their application that have not yet been fully learned. Whether or not any experience qualifies on either of these two counts depends on the class of individual.

A list of the lessons learned by the CCC boys on the McVey fire would have a very different content from the list that would be most appropriate for their foremen. Similarly, some of the lessons learned by members of the supervisors' staffs of the Harney and Black Hills Forests would sound trite to a southern California fire fighter, although other features of the job might have considerable thought-provoking challenge to outsiders.

The following comments represent an attempt to sort out experiences of the McVey fire from which lessons may be drawn that are of interest to officers concerned with fire-control strategy on big fires. For the most part they do not represent anything new in principles of fire control.

The McVey fire itself was a conflagration in flashy fuels, in rolling topography, with variable winds. This combination is designed to test the resources of any fire boss. Rates of forward spread on wide fronts up to 120 chains per hour occurred. Direction of spread varied, and rate of increase in terms of acreage burned went as high as 2,900 acres per hour during the run of Tuesday, July 11. The cover type of the whole area was ponderosa pine, interspersed with small meadows. Over two-thirds of the area burned consisted of thinned stands of ponderosa pine, in which the thinning slash formed a continuous layer of fuel of varying density and stages of decay, dating from 1933.

Although this fire reached a total area of 22,000 acres, it was controlled as a second-period fire with a total of 46 miles of held line. Because of the blow-up on July 11, only 10 miles of line were still held by 8 p. m. of that day. The additional 36 miles were built in one work period, from 8 p. m. Tuesday night to 9:15 a. m. Wednesday. The rate at which the fire burned out was remarkable for a timber fire. Once the entire perimeter was controlled, the whole area went cold almost overnight. This seems to have been due, in a large part, to the absence of heavy dry material, to the burning out done on all fire lines, and to the extreme heat produced by the slash on the ground.

The lessons to be learned from this fire for the local organization have the usual and familiar character of lessons in fire strategy, in organization, in speed of attack, in methods of attack, and in fire prevention and preparedness. All of these have been discussed at some length, and most of them on which it was agreed that something definite and constructive could be done locally have been duly listed in the conclusions of the Board of Fire Review. For the most part, they will not be repeated here, but an attempt will be made to go back a little further in a consideration of the significance of facts brought out by fires such as this one.

One of the first things that seems important to recognize is the inadequacy of existing fire-fighting methods to meet and overcome all kinds of fires. A 1-acre fire may be only a smoldering spot or it may already be as dynamic as a small tornado.

Most of our theory of fire-control tactics is based on a two-dimension idea, and the control of a fire is usually pictured as the solution of a problem in plane geometry. It seems to me that this type of thinking has carried over too far into ideas of application on the job, so that the experienced fire foreman himself comes nearer to a full realization of the potentialities of a given fire in the third dimension than does the so-called fire-control expert.

This of course, sums up to our inability to cope with crown fires. It is not a new subject but it has been rather studiously ignored in discussions of fire fighting. Certainly, this one factor looms large in the history of the McVey fire.

Assuming that nothing could be done during the height of the spread of this fire through the crowns, there were lulls during which it might have been controlled if certain things could have been done quickly enough. These "ifs" comprise debatable points from which some lessons may be drawn. During the first afternoon and evening, from 6 p. m. to 11 p. m., the fire dropped out of the crowns and stayed relatively quiet. There were 10 miles of fire line to build, which it was expected would be complete by 2 a. m. As it turned out, this would have been completed, probably by midnight, but the blow-up at 11 p. m. with less than one-half mile of line still to build resulted in losing nearly all that had been accomplished. A plan of attack designed to complete the job before 11 p. m. might have saved the day.

It has long been realized that it is unsafe to stake everything on the assumption that a fire will slow down at night. Yet fires do so so commonly that both the forester's and the regional policy are based on overnight action which is judged to be adequate on a big fire if sufficient manpower and facilities are mobilized to control a more or less static fire perimeter before 10 a. m. of the next day. On the McVey fire, forest officers allowed themselves a large safety margin, but as it turned out, not enough, since they did not foresee the critical necessity of a safe perimeter that could be held against all odds by 11 p. m. of the first night.

Regardless of how feasible such an accomplishment might have been on this particular fire, it, of course, presents a very real question in the case of future fires. Will it ever be possible to predict the behavior of an exceptional fire far enough in advance to insure the exceptional intensity of attack required? Ways in which Region 2 officers believe such foresight might be improved are: Through improved fire-danger ratings, improved fire-weather forecasting, and through better recognition of potentialities of local fuel hazards.

The next lesson of critical import and perhaps the one of most constructive value of all is that of the strategy of control in an aggressive fire such as this. Although the main head or heads of the fire took one direction, then another, during its run, prevailing winds and past experience with such fires in this locality have revealed that the odds are four to one that the greatest conflagration threat will be to country to the east and northeast of the fire. This was well known, yet the timing of control effort was such that the most northerly and westerly extensions of the fire were the last to be controlled. As a result the blow-up here flanked all the hard-won control line to the east. This was a question of judgment at the time and not as obvious a failure as it may sound in review. The worst fuels and the most aggressive head of the fire were given first attention, and the hardest part of the fight seemed already won when the fire made its new drive northward on its west flank. This extension set the stage for the final run eastward on a front of conflagration proportions. The west flank of the fire had already burned out to a wide expanse of noninflammable grassland which gave a strategic advantage. Had the progression of safe-control line been entirely from the grassland eastward along the north flank and from the completed south line northwestward along the east flank, the investment in fire-control line would have been better protected against loss and the same blow-up with the same amount of uncontrolled perimeter farther east at 11 p. m. would have been far less disastrous, in terms of both a narrower new head and less lost line. This lesson in importance of sound strategy would not have become apparent at all had the fire remained quiet an hour longer or had the fresh crews scheduled for this sector been the first to arrive and start work instead of the last. Similarly, more manpower or increased efficiency in line construction, sufficient to complete all control line before 11 p. m., might have resulted in success with the timing used.

After the fire had made its run northward another lull occurred between the hours of 2 and 7 a. m. of the morning following. Forces were reorganized and a fresh attack was made during this period which carried considerable promise of success in spite of a greatly increased perimeter. In this case little fault can be found with the strategy planned, but its execution failed from circumstances which may also carry some lessons.

The critical sector of the new line was being pushed rapidly from both ends by experienced fire foremen using the one-lick method and burning their line clean as they went. Follow-up crews were organized to guard the hot line and to control spot fires. The latter failed to accomplish this. No one knows exactly why, except that this job turned out to be far more exacting and required far more supervision and more ingenuity and action than did the construction of a reasonably safe control line alone. Both on this occasion and at other times during the fire the rate of production of a reasonably acceptable control line, including burning out, did not represent the rate at which the fire was being controlled. This raises a question of tactics where fire line is being built rapidly. The job of holding the line built calls for far more than is implied by either the term patrol or mop-up. It represents on a fast-running fire a desperate defense action, since the advance crew cannot wait to see the fire finally die down behind it, but must pass on to the follow-up crews the responsibility of making good the advantage gained. When 2 to 3 miles of such line is handed to a sector boss he must drastically change the approved method of organizing the job, which was based on mopping up a dying fire edge. Apparently this was not well enough done. The conclusion then is that organization of crews must be handled on a very different basis than the conventional mop-up or patrol action when fire line is put in rapidly by an advance crew or by mechanical means.

A further experience on the McVey fire that was baffling to sector bosses was the tendency of backfires to spread inward toward the oncoming crown fire in the surface litter just as intended, and to go into the crowns just before reaching the main fire. But when the two met they seemed to "bounce" right back through the unburned crowns toward the fire line without any noticeable drop in intensity. This did not always occur but happened so often as to make backfiring ineffective at close range and very risky at longer distances. Apparently the nature and force of the convection drafts is the deciding factor. It is a challenge to backfiring theory and strategy.

Out of these experiences there may be resolved several points of challenge to existing fire-fighting theory and practice. These points, rather than the lessons discussed, will be listed in the form of questions.

1. How can forest fire-fighting theory and practice take better account of fire as a force to be dealt with which varies as a problem not only with the area involved but also with the varying rate at which heat units are being released and with the convection forces being generated?
2. How can the requirements of successful control action for each individual fire be predicted more successfully?
3. What principles of fire-control strategy can be defined and set up for general application?
4. What changes in crew organization should be adopted to insure holding long stretches of fire-control line built rapidly along the perimeter of an active fire?
5. How can the use of backfiring be reduced to a dependable practice in combating crown fires?

Ax Handle Treatment.—In an effort to reduce the large number of loose ax handles which result when axes are stored in rather arid portions of some of the forests on the coast, we requested the Kelly Ax Co. to make a few experiments. The experiment consisted of nothing more than reducing the moisture content of the eye portion of the ax handle considerably below that required by the specification, the theory being that after driving the handles home the portion within the eye will, because of its hygroscopic nature, pick up enough additional moisture to equalize with the rest of the handle and produce a normally tight fit.

By placing the eye end of the handle in a drier, the moisture content was reduced to between 8 and 9 percent back to the point where the handle leaves the eye. This removes some of the moisture, but it also drives some of the moisture back into the body of the handle, and after the handle is driven in it is believed that some of the moisture goes back into the eye portion and thereby prevents undesirable brittleness.

Six axes so treated were sent to the Los Padres National Forest and placed on the north end of the forest where they would be subjected to very low humidity practically all of the summer season. No looseness has developed in the handles, and the forest has continued to use the axes along with other axes which were not so treated in the handling process. In the latter group looseness did develop.—Region 5.

SEPARATING THE GOOD PEOPLE FROM THE CARELESS

A. G. Lindh

Division of Fire Control, Region 1, U. S. Forest Service

This is indeed a brave and ambitious title. So also is the entire concept of the article. The author proposes a scheme which may look radical as a whole, but so did closures when they were first proposed. The actual procedure and system involved may seem heavy, but the results might be more per dollar of money and hour of time than obtained from other forms of fire-prevention effort. It is an idea that calls for incisive thought. There should be discussion of the workability of the scheme and the practical values it may have; certainly we can overlook no new device which offers any chance to improve the prevention record.

For as many years as there has been organized fire protection on the national forests, we have carried on a fire-prevention campaign aimed at educating all people who use the forests. As the years went by, progress could be noted. We have not anywhere near approached the point of diminishing returns, if for no other reason than young people continue to replenish the stock of those who have not been educated.

Through the years and even up to this day, we have discovered that we could not educate 100 percent of the people effectively, since a small minority will continue to be careless, thoughtless, or malicious. Because of the existence of this minority, we have each year found it necessary to close certain areas of high hazard and heavy use to travel and enjoyment by all people. We have rather uniformly informed the people that while the closures had to exclude all people it was necessitated only by the careless, the thoughtless, or the malicious few. Since we had no means of segregating this small minority, it followed that we unjustly had to exclude the careful, or thoughtful, and well-meaning majority.

In many instances we have failed to close areas of high hazard and heavy use, when from the standpoint of good management in fire protection, we should have closed them simply because we knew we would be excluding the vast majority of people who are careful. As a result, we allowed the small minority freedom in such areas when, by rights, they should have had no freedom.

Analytical thought on the problems indicated leads one to the conclusion that we should at least start thinking deeply about a method of segregating the sheep from the goats. If we could segregate the two groups, even along broad lines, then we could increase the number of closures against the minority and decrease the areas closed against the majority. As a starter, to stir up our thinking on this problem, the following plan is suggested:

1. Develop regionally a small textbook on the arts and sciences of being a good woodsman. This would serve as the first step in a training program. This would enable our forest users to grow in their knowledge of the essentials of woodsmanship necessary to make them safe as occupants of even the most hazardous areas. There would be developed at the same time for regional use the outline for an examination to be given at every point throughout the field to all local candidates for a certificate of skill in fire-prevention woodcraft. This would be an examination somewhat similar to the automobile driving tests given applicants in most States for drivers' licenses. It would include sufficient practical tests to insure that the candidate had more than "book larnin."

2. Applications for fire-prevention woodcraft certificates would be submitted through the local forest officer. He would furnish the applicant with a textbook and outline of what was expected of him.

3. On a designated date to be set locally, the forest officer would conduct examinations, both written and practical field tests, with a rigid efficiency requirement before we would give the candidate an unlimited certificate of merit.

4. Cards or certificates would be issued by the regional forester (who must necessarily maintain a master card list) only after the graded examination papers were submitted by the local forest officer with a statement concerning the candidate's fitness.

5. A card or certificate of merit in fire-prevention woodcraft when issued would be a passport for that citizen into any part of any national forest in this region at any time. In other words, the owner of such a card would be entitled to entry into hazardous, closed areas established for the purpose of keeping the careless people out during seasons of high danger. The card would bear the fire-prevention code.

6. The card would be canceled upon presentation to the regional forester of sworn statements by two forest officers that the owner of the card had violated the fire-prevention code. When a card was thus canceled, the owner would have the right of appeal and trial before a jury of forest officers.

Discussion.—One specific purpose of this system would be to enable fully qualified local people to enjoy freely the privileges in any part of the forests which would be opened to all people if all people were careful. It would remove the objection, now chiefly arising from local people, to the closing of areas which we are now forced to close if we are to meet our public responsibility in the handling of critical fire situations.

The plan would set up a definite objective in education of the people who use the forests. Such training, if properly handled, would be popular with them. If we extend our education and examination efforts only to an average of 20 people per ranger district per year, we would still be able to handle the majority of our local forest users within 5 years in Region 1. In some large population centers we might have to detail several forest officers every spring to hold training courses and subsequent examinations. We could no doubt get the cooperation of sportsmen's groups and such groups as the American Legion in handling the educational work. This would require the time of forest officers only to give the examinations.

The adoption of the suggested plan might require the making of a new regulation by the Secretary of Agriculture, and the chances are it would spread nationally if it were adopted in one region.

Considerable careful work would be required to outline the textbook and the practical and written test. I believe, however, this would be justified. The subjects that appear highest in priority for such training would be:

1. Location, building, and putting out of several campfires under a variety of conditions.
2. Proper smoking habits and a carefully worked-out smoker's code.
3. Ax, shovel, and bucket requirement and a demonstration of proficiency in the use of the articles in suppressing fires.
4. The careful outlining of the requirement that the applicant must know how to put out small fires and report them promptly. (He probably should be required to take such suppression action if he is to continue holding his card.)
5. A knowledge of miscellaneous fire risks such as bottles, or other glass, automobile exhausts in dry grass, sparks from stovepipes, danger of spontaneous combustion, etc., and how to avoid them.
6. How to build and maintain a clean and sanitary camp.
7. Obligations in the care and maintenance of signboards.
8. Respect for other people's rights and property.
9. What to do if lost.
10. The obligation to educate and advise others who are not skilled in woodsmanship, within the limits that the man himself sets as a code of conduct in dealing with his neighbor.
11. Knowing how to increase care with all sorts of fire risks when conditions get extremely critical. (The textbook might contain a brief guide as to the effect of temperature and humidity on fuel moistures and the resultant ease of ignition.)

This tentative plan is outlined to encourage discussion with the objective of doing something more effective in the way of fire prevention. In other words, this is written up to shoot at.

TECHNICAL REPORT ON THE PARACHUTE JUMPING EXPERIMENT

David P. Godwin

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Because of its spectacular nature, the parachute-jumping experiment conducted last fall on the Chelan National Forest in Northern Washington drew more attention from the press, the magazines, and the movies than any other one Forest Service activity in 1939.

On the date of this writing (January 16) as the manuscript of this April issue is about to be cleared from the Division of Fire Control, the well-arranged, well-written, and very comprehensive technical report on the project was received from Region 6. Counting typewritten text, illustrations, and appendix, it consists of 146 pages and is a guidebook containing all the technical information on this subject.

Its table of contents indicates the scope of the work:

- PART I. Historical:
  - Introduction.
  - Initial action.
  - Approval and finance.
  - Contract.
  - Personnel.
- Part II. Equipment:
  - Airplane.
  - Parachutes.
  - Trial parachutes.
  - Dummy parachutes.
  - Live-jump parachute training outfits.
  - Repair equipment.
  - Timber jumper's equipment.
  - Radio equipment.
  - Fireman's outfit.
- Part III. Conduct of project:
  - Project base.
  - Preparation for the experiment.
  - Experiment procedure:
    - Trial parachute tests.
    - Dummy parachute tests.
    - Live jumps.
  - Techniques used:
    - Getting the jumper ready.
    - Air technique in letting out jumpers.
    - Jumper's approach to exit.
- Part III. Conduct of project—Con.
  - Techniques used—Continued.
    - Jumper's "take-off" from airplane.
    - Jumper's descent to ground.
    - Preparation for landing.
    - Let-down out of trees.
    - Retrieving the parachute.
    - Tools to smoke chaser.
- Part IV. Observations.
- PART V. Conclusions.
- Appendix:
  - Airport equipment.
  - Rolling the trial chute.
  - Training smoke jumpers.
  - Rough sketch of proposed training tower.
  - Loft equipment for servicing 16 men.
  - Smoke jumper's suit and equipment.
  - Fireman's tools (proposed) for timber jumpers.
  - Weights of component parts of the equipment.
  - Dummy parachute tests (field notes).
  - Live jumps (field notes).
  - Mental and physical reactions to free fall in space.

After eliminating part of the appendix, the report will shortly be duplicated and distributed to the field force of the Forest Service. In addition, effort will be made to provide limited distribution to other agencies engaged in fire-control activities.

Much thought and study must be given, this winter, to the organizational aspects of this new technique so that a better understanding may be had of its practicability. But the results of the field work are so promising it is proposed to set up working units, integrated with the fire-control organizations in two western regions.

COMPETITIVE EVENTS FOR FOREST FIRE FIGHTERS

ANNE C. ALLEN

State District Forest Fire Warden, Rhode Island

On a Saturday in August of 1939 there was held at East Greenwich, R. I., the first "Southern New England Forest Fire Fighters Field Day." In all respects it was a great success. As a builder of esprit de corps such an event is invaluable and is worthy of emulation, on larger or smaller scale, wherever fire-fighting groups exist. The author provides us with a lively program.

New England has always believed in competition, leading the race for efficiency. The old-time Handtub Musters or Squirts, where the competition of firemen reached its highest peak, originated in New England. Early in the game of fire fighting the outstanding value of these musters in building up efficiency, teamwork, and company spirit, through the guise of muster practice and actual competition, became self-evident. Musters flourished and the annual championship became a mighty big thing.

Training in forest fire fighting in New England, however, has been haphazard at its best. But following the hurricane of September 1938 the entrance into New England of Forest Service trainers with a systematic scheme of training in forest fire fighting technique for CCC crews, State and town crews alike, forest fire fighting reached a uniformly high level never before attained. After the intensive winter and spring training, it was thought worth while to arrange a field day, so that the results of the training might be brought to public attention and, at the same time, serve to create healthy competition between crews.

At first it was hoped the field day would take in all of New England. Technical difficulties arose, however, and the event was finally staged as the "Southern New England Forest Fire Fighters Field Day," the States of Massachusetts, Rhode Island, and Connecticut competing. The State of New Hampshire later put on a "Paul Bunyan Day," with State-wide competition in forest fire fighting and logging. The slack period between spring and fall fire seasons was chosen as a good time for the field days.

The Rhode Island Department of Agriculture and Conservation, with the cooperation of the Forest Service, sponsored the Southern New England Field Day. M. L. Holst of the Forest Service and A. C. Allen of the Rhode Island Forest Fire Service were asked to map out a program of contests in forest-fire fighting techniques and to compile the rules and regulations. The New Hampshire Field Day used these same contests. They are outlined here with the hope that they may become standard throughout all forest-fire-fighting outfits that may have occasion to put on such events. They have been proved by actual use to be extremely workable.

Crew Contests

Hand-Tool Fire Line Construction Contest.—

1. Contest limited to a 20-man crew and foreman. No patrolmen will be left on line.

2. Contest will consist of constructing to mineral soil a fire line 12 inches wide and 1,000 feet long, using the progressive line construction method.

3. Contestants will be aboard truck. At signal from starter they will unload, receive tools, and start line construction. Line will be considered finished when last man passes the 1,000-foot mark.

4. Tools for contest will be furnished on the grounds. Record time for event: 3 minutes and 45 seconds.

Portable Power Pump Line Construction Contest.—

1. Event limited to 10-man crew.

2. Gasoline tank, intake and discharge hose must be connected to pump, after pump has been set up at water source.

3. Hose to be dry 1½-inch linen forestry type.

4. Hose may be laid from rolls, reels, backboards, or packsacks.

5. Event will consist of constructing 500 feet of water trench as follows: Pump and hose to be on truck; at signal from starter crew will set up pump, lay 300 feet of hose to site of fire, and there construct 500 feet of water trench. Contest will be considered completed when nozzleman passes the 500-foot mark. Trench must be so constructed that the water penetrates to mineral soil. Record time for event: 4 minutes and 53¾ seconds. Recommended scoring card for judges of the two events just described:

	Percent
1. Time	40
2. Quality of line	40
3. Spacing of men	10
4. Safety	5
5. Spirit of crew	5
Total	100

Portable Power Pump Efficiency Contest.—

1. Event limited to 10-man crew.

2. Event will consist of setting up pump, laying hose, and tripping target.

3. At signal from starter crew will unload pump from truck, carry same 100 feet to source of water, connect fuel tank, intake, and discharge hose, lay 300 feet of fire hose, install siamese and lay 300 feet more hose on each connection of siamese to nozzles, fill hose with water and trip 2 targets at a distance of 30 feet from the nozzles. Contest will be considered finished when both targets have been tripped.

4. Hose to be dry 1½-inch linen forestry type. Record time for event: 1 minute and 49 seconds.

Motor Forest Fire Tank Truck Efficiency Contest.—

1. Crews limited to 7 men.
2. Hose may be carried in any manner—laid in body, reels, pack-sacks, backboards, etc.
3. Hose to be 1½-inch.
4. Discharge ports of pumper must not be more than 4 feet over the starting line towards nozzle end of hose when pumping.
5. Truck to be placed with front wheels on white line and motor running. At starting signal (whistle) truck to run 150 feet to starting line. Crew proceeds to lay two 200-foot lengths of hose in parallel lines, place nozzles on lines, connect lines of hose to discharge of pump, and pump water through hose and nozzles, from tank on truck, and trip targets (2) 30 feet from nozzles. Starting time to be taken when front wheels of truck cross a timing line 50 feet from the starting line. Finish time to be taken when water trips both targets. Record time for event, using linen forestry hose: 46 seconds.

Individual Contests

Back-pack Pump Contest.—

1. Back-pack pumps to be furnished on grounds.
2. Full pumps to be located on white line.
3. Contestants to be lined up on starting line 100 feet in rear of pump cans. At signal, contestants will run to pump, pick it up and place it on back, proceed 200 feet to stone wall or log barrier at least 3 feet high, cross barrier and continue 200 feet to white line, then by the use of the pump, fill a 1-quart, No. 3 tall can, two-thirds full of water from a distance of 10 feet. Record time for event: 2 minutes and 25 seconds.

The customary log chopping, log bucking, and log burling (if a pond is available) events round out a very satisfactory field day program. Two other events that the crowd seems to enjoy most heartily are an ax-throwing contest, using the standard Pulaski tool, and a water fight between portable pump crews, using a 30-inch rubber beach ball.

The results of the two field days held in New England indicate that events of this kind are one of the best means of selling fire prevention to the general public.

A Better Nozzle for Back-Pack Pumps.—A little over a year ago the D. B. Smith Co., of Utica, N. Y., made available a new design nozzle for back-pack outfits. Essentially, it is nothing more than a midget Boston garden hose nozzle, the same as the one we all use to water our lawns and gardens. The same range of streams is available as in the garden variety. After having been tested for over a year, we can report that the field considers it a much more practical nozzle than any heretofore available. An interesting sidelight on this device: About 10 years ago we tried, unsuccessfully, to induce the Smith Co. and others to manufacture this nozzle. After a lapse of 9 years, and without urge, the device is made available. Test one. You will be pleasantly surprised.—F. W. Funke, *Region 5.*

CHECK OF CENTRAL STATES FIRE-DANGER METER

R. R. Reynolds
Associate Forest Economist
and
David Bruce
Junior Forester
Southern Forest Experiment Station, New Orleans, La.

Since November 17, 1936, the Southern Forest Experiment Station has been collecting daily weather data at the Crossett Experimental Forest for use in determining fire-danger ratings. The measurements made include temperature, relative humidity, wind velocity, and rainfall. A continuous record of humidity and temperature is obtained; wind velocity is measured twice a day, 7 a. m. and 12 m.; and rainfall is measured once a day, at 5 p. m.

Twice daily, at 8 a. m. and 12 m., these readings are given to the dispatcher of Arkansas Forestry Commission District No. 1 and to J. C. Ross, district ranger in charge of the local unit, who have used them to supplement general opinions of fire danger and to estimate the approximate size of the suppression force needed at any given time.

Since November 16, 1936, the district ranger has kept a daily record of the weather readings furnished by the Crossett Experimental Forest, and opposite these readings has noted the number and size of all fires occurring within the local unit, which consists of about 605,000 acres of second-growth shortleaf-loblolly pine-hardwood timberland. It is therefore possible to compare weather readings with number and size of fires.

The Lake States Forest Experiment Station has furnished a copy of their "Central States fire-danger meter" for use in this comparison. By use of this meter, which rates fire danger on the bases of (1) wind velocity, (2) relative humidity, (3) days since rain, and (4) condition of vegetation, the daily fire-danger rating was determined at Crossett, Ark., for the period of 752 days for which weather and fire data were available. In this check the daily rating was based on the 12 m. weather reading, since the maximum fire danger occurs shortly after noon, and since contact with fire wardens and suppression men is made usually at this time.

As one of its measures of fire danger, the Central States meter uses relative humidity, which indicates the moisture content of the fuel and hence the ease with which the fuel will ignite and burn. In evaluating fire danger, this meter also uses three different conditions of vegetation—(1) green, (2) curing, and (3) dead. In this check, because of local conditions, vegetation was assumed to be "curing" during the early part of the growing season (April–June), and for the rest of the year it was assumed to be "dead." Therefore, this check should be considered to be on a *modified* Central States meter.

The danger rating, which was determined from the meter, as outlined, was placed opposite the fire and weather data, which were then summarized by grouping all days with the same fire-danger rating. Since a summary of the weather data would show only the average conditions that determined the danger ratings, and since actual conditions for a given day are used in determining fire danger, these data are omitted.

Table 1, which summarizes the fire data, is interesting because it shows a relationship between the danger rating when using this meter and (*a*) number of fires per day and (*b*) acreage burned. Average number of fires per day was determined by dividing the total number of fires on days with a given danger rating by the number of days on which this rating occurred. This figure indicates the frequency of fires for days with the given danger rating during the period of the check. As will be noted in the table under danger rating 1 (first line), the value of 0.1 fire per day indicates that there was 1 fire for every 10 days that had this rating at 12 o'clock noon. Similarly, a fire every third day with a rating of 2; a fire every second day with a rating of 3; and so on up to 8 fires a day with a rating of 6. These values can be used as the probable number of fires to expect for the various danger ratings in estimating the necessary suppression force. Also, since the suppression crew must extinguish perimeter of a fire, a rough estimate was made of the average perimeter per day.

The information summarized in the table shows that there is a definite increase in the number of acres burned per fire as the danger rating increases. It is also interesting to note that the number of fires per day increases with the increase in danger rating. The total loss of acreage per day can be obtained by dividing the total acreage burned in any danger class by the number of days in that class. It is entered in the summary. The average acreage loss per day for a given rating is perhaps of greatest interest in estimating amount of damage.

TABLE 1.—*Comparison of fire-danger ratings with occurrence and size of forest fires in Crossett district, Nov. 17, 1936, to Jan. 1, 1939*

Central States meter danger rating	Number of days	Total number of fires	Greatest number of fires per day	Number of days without fire	Percent of days without fire	Total acreage burned	Average number of acres per fire	Average number of fires per day	Average number of acres burned per day	Estimated average perimeter burned per day
1	173	18	3	160	92	29	1.6	0.1	0.2	1
2	101	38	6	82	81	133	3.5	.4	1.3	11
3	216	131	8	160	74	746	5.7	.6	3.5	23
4	193	314	25	104	54	2,135	6.8	1.6	11.2	65
5	67	224	14	20	30	1,865	8.3	3.3	27.8	160
6	2	16	15	0	0	1,447	90.4	8.0	723.5	1,200
Total	752	741	25	526	70	6,355	8.6	1.0	8.5	----------

The danger classification of the Central States fire-danger meter might be improved for use in this locality. As generally used, the lowest danger-class on any meter indicates weather conditions during which fires will not occur. Since 18 fires have occurred here on days of danger-class 1, as this meter is now graduated, the meter should be regraduated so that class 2 will include these days. Also on most danger meters, only about 1 day in 100 is in the highest danger class. Since, as used here, there were no days in danger-class 7 and only two class 6 days in a total of 752, a regraduation should be made also in the other end of the scale.

Even with a meter in which the upper and lower danger classes are improved as described, there is need for local administrative judgement in determining the action to be taken for a given fire-danger rating. The practice of burning the woods by local inhabitants, and the tendency of reduced visibility to increase the discovery time of fires, must be considered in planning the action to take for given danger ratings. The results of the present check, however, indicate that a well-designed fire-danger meter will be of great value in many phases of fire-control work on this and similar areas, and that its correct use permits the forest administrator to save money in protecting his forest. Before a fire is discovered, it will serve as a basis for varying the presuppression organization; and when a fire is discovered, it will serve as a guide to the dispatcher in estimating the size of suppression crew required. Also it will act as a guide for the regulation of debris burning. These uses alone should make an accurate fire-danger meter of great value to those in charge of fire protection in this region.

Family Forestry.—Dwellers in nonforested regions are pretty well convinced—when they don't forget—that fires are bad business for the country as a whole. But how about the one class that is responsible for so many of our fires—the local settler? We haven't made enough headway in selling him the idea, mainly, I think, because we are using a sales talk that sounds good to us rather than one that sounds good to him.

Let's look at a more or less typical settler down in the southern woods. He has 80 acres, a mule, a cow, 2 sows, a sack of flour, $4 in money, a wife, and 8 kids. He's doing the best he knows how but "jest can't seem to git no place." He's living 1 day at a time with no prospects of things getting better. God knows, he wants his kids to have some of the things other kids have, but they'll be danged lucky if they get enough to eat come spring.

His timber isn't bringing him in anything. If it wasn't there he'd have more pasture and more plow land. No use telling him that in 10 or 20 years he can crop a thousand dollars off that timber. His family has to eat right now. Ten years from now they can look out for themselves. No use generalizing about timber depletion. If all the lumber companies in the world go busted—what of it. Besides they are rich anyway. Suppose a bunch of woods workers do lose their jobs. They'll just have to look out for themselves same as he has to do. Anyway, they are probably rich; they have jobs. He can't even get a job.

If we want to sell this man on forestry, we will have to do it in terms of more food and clothes now, not 20 years from now, nor even 1 year from now.

I believe it can be done. Probably not on a basis of sawlogs or pulpwood, but rather through forest byproducts. It must be something in which the whole family can take a hand. It means showing this settler what to produce and then showing him how and where to market it. Some of the possibilities (depending on location) are: Berry picking, gathering roots and herbs, seed collection, ferns and foliage for florists, hand-made wood products such as ax handles, etc., insect and plant collecting for wholesalers of school and laboratory supplies, favors and novelties—the list is almost endless. The point is that any time the kids can drag in $10 or $20 a year out of the brush, pa is going to keep that patch of timber working and keep the fire out of it.—A. G. Simson, *radio engineer.*

USE OF THE McLEOD TOOL

Allen S. Dakan

Project Superintendent, Camp F-64-C, Pike National Forest, Region 2

McLeod tools may not be new to the Forest Service generally, but my introduction to them has been quite recent. Last Spring we assisted L. P. Brown in preparing for his ranger-training school at Manitou Park. He brought forth two of these peculiar rake-and-hoe combinations to be painted according to fire-tool standards. We looked them over and tried them out on a few short stretches of line around the camp. They seemed effective in the light grass and duff of open ponderosa stands which are common on the Pike National Forest. A short time later, 8 of the tools were ordered for equipment in the fire-tool boxes at the main camp and side camps. The standard 20-man cache was equipped with 4 and the side camp 10-man boxes with 2 each.

During this fire season we have used the McLeod tools on practically every fire which we worked. Most of these fires have been located in the open ponderosa types where the duff cover varies from nothing to as much as 6 inches deep. The soil has been mostly loose, disintegrated granite. On sites of this nature the McLeod tool was ideal for both line building and mop-up. When using the "one-lick" method, four men could be lined out on small fires, preceded by the foreman marking and clearing line and followed by one or two men with shovels for clean-up. The speed at which line could be built was surprising.

On one fire, the first on which the tools were used, we built line using the one-lick method and McLeod tools. Five men built 23 chains of line in 30 minutes, or, for that short period, at the rate of 9 chains per man-hour. This was on the average site with duff as much as 4 inches thick in places, some rocky ground, and some down timber that had to be cut. The fire was especially hot and had started to run up several trees when we first hit it. In this instance we found that working at right angles to the line using the hoe side of the tool was most effective and fastest, especially in the heavy duff. The line could be cut at the very edge of the fire with a minimum danger of throwing fire outside, and the duff thrown out could be scattered most effectively. On other fires, the tools have been equally satisfactory.

For mop-up, the rake end of the tool is excellent. Two men with McLeod tools and one with back-pack pump can rake a hot spot while it is being sprinkled, doing a very effective and rapid job of puddling. This was much faster and easier than the same work when done with shovels.

We are thoroughly sold on this tool for use in this type of country. Even though a little awkward to use in rocky ground, it is not much if any worse than a shovel.

NEW PRACTICE IN BURN TREATMENT

FRED C. MILLS

Director, Health and Safety Service, Boy Scouts of America

As a result of a visit to the Washington office last fall by Fred C. Mills of the Boy Scouts of America, a cordial cooperative relation has been established with the national headquarters of that important organization. Mr. Mills' major interest naturally lies in the field of health and safety, and the highly developed practices of the organization are largely the result of his efficient efforts. This article is an abstract from his letter concerning what is known as the Harborview Hospital burn treatment which was developed by Dr. Hilton W. Rose, in charge of the burn service at that Seattle institution, now King County Hospital.

When I first went to the Harborview Hospital, Dr. Rose was not there, but I talked with the house doctor and he explained the burn treatment in considerable detail. The following day I called on Dr. Rose and he gave me more of the background and some additional data. Briefly, the treatment, which seems to be extremely practical, is as follows:

The patient, when brought to the hospital, was immediately immersed in a tub of 60° temperature water without attempting to remove the clothing. The temperature is gradually raised to blood heat. The reason for putting him in cold water first is that the burned tissue, according to Dr. Rose, is microscopically exactly the same as frozen tissue. It is a well-established fact that when the blood is too rapidly put back into circulation in frozen tissue, that tissue is broken down, which is likely to cause considerable destruction and may result in a gangrenous condition. As the circulation is gradually brought back to normal, shock is diminished, particularly as a result of the oxygen being excluded from the burned surfaces. The patient remains in the tub about 4 hours. When his condition is such as to permit it, the clothing is removed and the burned surface is cleaned with green soap applied with gauze. Narcotics are administered, the patient is removed from the tub, dried thoroughly under lights, and coated with a ferric chloride or silver nitrate. He is then placed in a bed where the top bed clothing is supported by framework and lights are maintained in order to keep the wounded surface dry.

In burn cases much of the fluid in the blood stream is absorbed by the tissues, seriously depleting the supply of the circulatory system, sometimes as much as one-half. This condition itself may be fatal unless the balance is corrected. Dr. Rose claims that this system does help to correct this condition. A saline solution is given when found necessary in order to increase the blood volume. Dr. Rose works on the theory that a burn is a wound, plus shock. He does not believe that there is any poison from protein absorption. This, I believe, is in line with the best information available. He does not use tannic acid because of the very thick eschar which is formed by it and which makes the location of an infected area which may develop beneath it difficult. This is not true with ferric chloride which forms a thin coating.

Dr. Rose's treatment sounds extremely practical to a layman. I have talked it over with several surgeons here and they are interested, particularly in his theory of delaying the return of blood to the damaged area. Dr. Kennedy, a member of our National Health and Safety Committee, chairman of the Fracture Committee of the American College of Surgeons, and head of Surgery, Beekman Street Hospital, is a little dubious about putting the patient in a tub even of sterile water while still clothed. He thinks that it might cause infection to develop.

The Fruits of Their Labor.—Bordering the east boundary of the Mt. Hood National Forest and within District Rangers Walters, Gordon, and Lynch's zone of influence, live a great people. These folk are farmers, ranchers, woods workers, and small-businessmen. They represent a good cross section of western America's rural and urban population. Their patriotism, citizenship, and interest in public affairs are outstandingly high. Their acts are not confined to lip service but to deeds which speak much louder than words. Community interest in their national forest is not exceeded anywhere.

Their interest, loyalty, and confidence in forestry is best expressed in their attitude toward fire prevention and suppression, and in timber management. In this area of 900 square miles live approximately 25,000 people. From among these people the district rangers have enlisted nearly 400 men in organized and trained fire-fighting crews, many of whom for 15 years have been going to forest fires at the call of their district ranger and many times without waiting for the call. Logging and sawmill operators, farmers, and stockmen have closed down their operations and their mills, and interrupted the work of their threshing-machine and harvesting crews that their men may go to a fire burning on their forest. County officials have purchased radio-equipped fire tanker trucks with pumps, fire hose, and fire-fighting tools, and manned them with trained operators who are on duty day and night throughout the fire season. They have announced their intention of harvesting county-owned timber under the selective-logging system advocated by the Forest Service. Loggers, millmen, woodcutters, and others whose business it is to work in the timber have requested the Forest Service to keep them advised on burning conditions in order that they may close down when it is unsafe to work. Farmers operate fire-danger stations with equipment furnished by the district ranger and report their recordings faithfully to him. County courts and individuals pay the Forest Service to dispose of their slash in order that it may be done safely and without injury to standing trees. Schools, churches, American Legion, Grange locals, and other organizations carry on campaigns of fire prevention and for better forest practices in the management of privately owned timber.

There are no State laws for eastern Oregon to regulate woods operations such as apply on the western slope, yet these people voluntarily impose upon themselves comparable restrictions. Incendiarism is unknown here and the new settler is quickly educated by his neighbors to be careful with fire in the woods.

Why are these people so forestry-minded and so fire-conscious? Is it a local economic influence? Or is it the result of carefully planted seed sown in fertile soil over a period of 30 years by patient foresters with a vision and with confidence in their cause?—Foster Steele, *assistant supervisor, Mt. Hood National Forest* (*Six-Twenty-Six*).

DWELLING SPARK ARRESTERS

F. W. Funke

Specialist in Fire Control Equipment, Region 5, U. S. Forest Service

Underwriters' statistics show that over 11 million roof fires occur each year, principally because of the lack of effective spark arresters. Despite the pressing need for devices which would reduce this tremendous loss, little has been done. The California region particularly has suffered from disastrous fires caused by embers being siphoned through house flues during periods of high wind. The Reginald Denny fire in the San Bernardino National Forest in 1926, was an outstanding example.

Early in 1928 the writer conducted a series of experiments in the laboratory with various types of house flues. Action of the flue gas and sparks was studied under a wide range of conditions. The study was incidental to other activity, however, and made slow progress. With the advent of the expanded work program in 1933 the work was shelved and not brought to the fore, until 1938, this time as a separate project financed by the Washington Office of Fire Control, M. Fram, junior mechanical engineer, being assigned to the project. The study was concluded in December 1939.

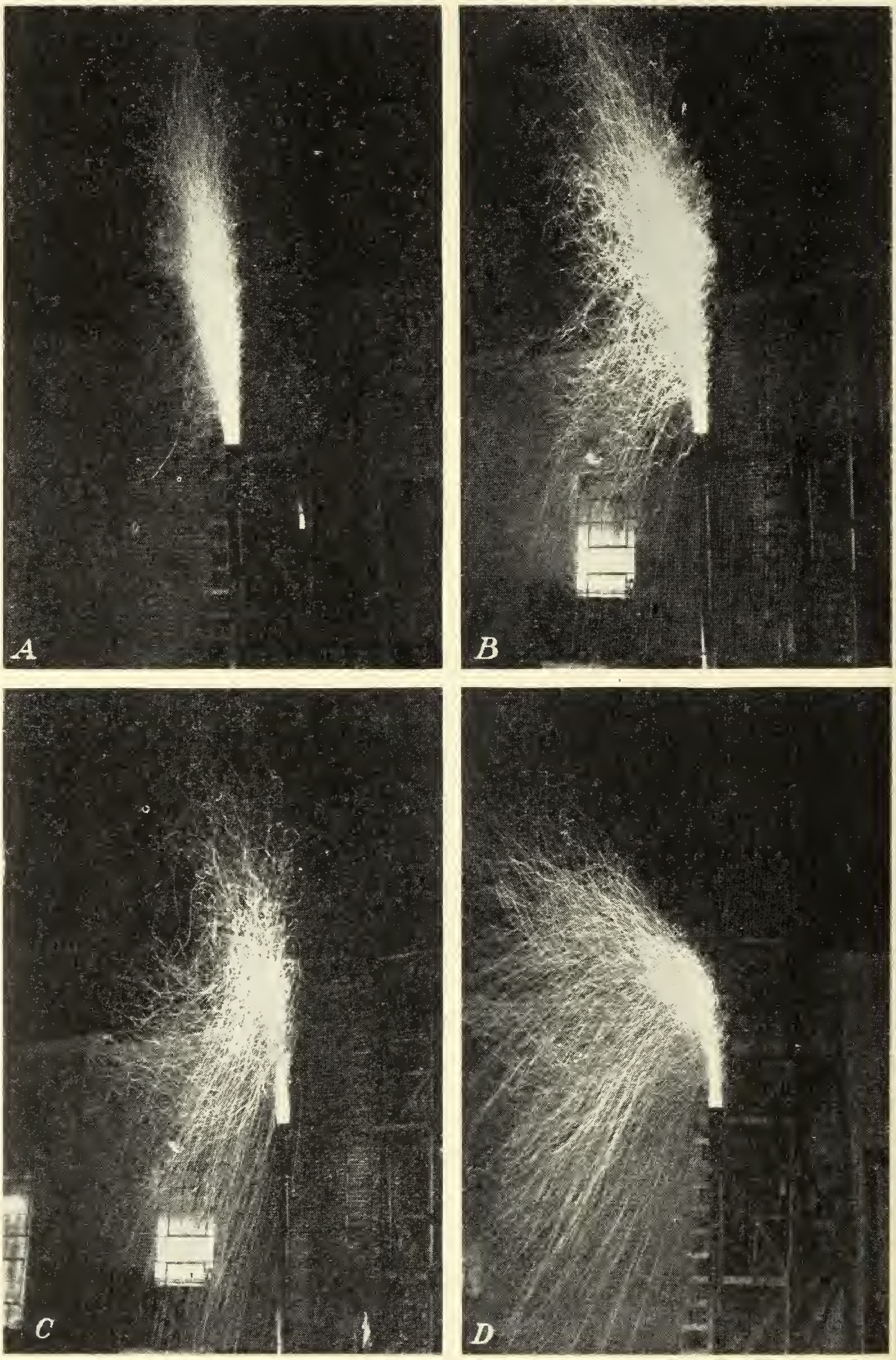
During the course of the studies looking toward development of an efficient and practical spark arrester, numerous arrangements of test flues were examined; actual test set-ups were studied; in fact, every conceivable application was considered. Spark particles were graded as to hazard or fire-setting qualities. Experimental types of arresters were built and tested under flue-gas velocities ranging from 10 feet per minute to 26 feet per second. The best features of the various arresters were included in a compromise design which, through field and laboratory tests, indicates that it is effective and practical for nearly all installations.

A report has been prepared which contains the data secured in the study. It is available to interested agencies upon request.

It would be misleading to convey the idea that all the answers dealing with spark arresters have been oftained in the study. Our search was directed to the design of a simple and practicable arrester which would be effective and serve our needs with a minimum of maintenance. Such a design is now available.

A very interesting photographic record was made of the spark paths. The exposure covers a period of 8 seconds, during which the individual path followed by each of the larger sparks is clearly shown. A standard cast-iron wood heater with an 11-foot smoke pipe was used during the tests. Graded sizes of sparks were injected into the gas stream.

It was determined by experiment that the efficiency, i. e., combustion loss and effectiveness of the arrester, is so closely related to definite proportional characteristics that for all practical purposes it can be stated: For any given size arrester of this design a proportionate

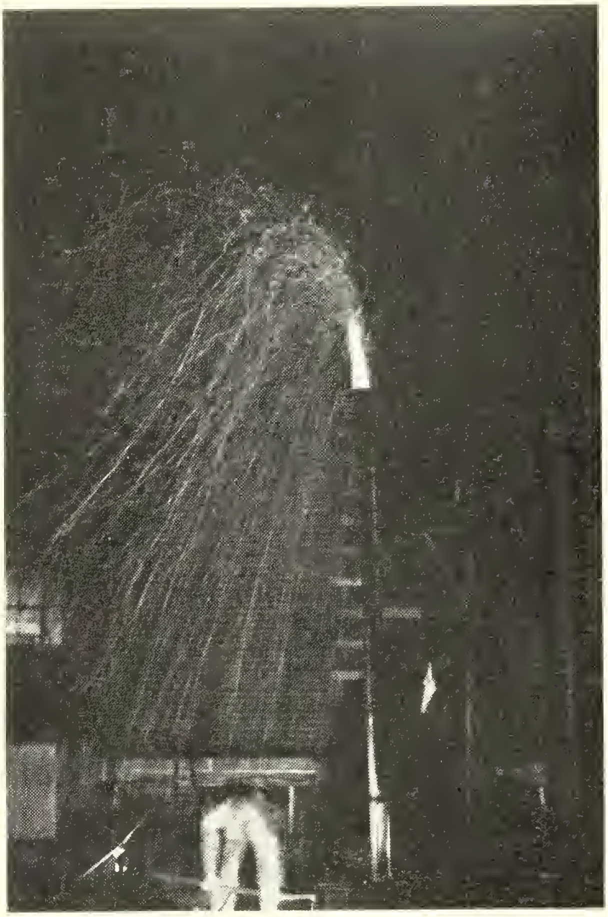


A, Small sparks of the nondangerous type. Practically all are consumed in the gas stream. *B*, Mixture of nondangerous and slightly dangerous size sparks. Paths of latter are clearly shown. *C*, High percentage of dangerous sparks. Small sparks broken during transit through flue are shown being consumed above stack. *D*, Heavier charge of sparks of the same grade as in *C*.

increase in size must exist between the inlet and outlet. This is clearly indicated on the plate.

The arrester may be installed at the top of the stack or at any intermediate point between the stove and the stack outlet. When installed near the stove, the arrester functions somewhat similarly to an automatic damper, restricting high-velocity gases produced by intense fires, and at the other end of the curve aiding gas flow from a low fire by permitting faster cooling and increased viscosity of the gas above the arrester. In passing, it may be worthy of note that the friction loss introduced by the arrester is the equivalent of a half length of 6-inch stove pipe.

Maintenance required by the arrester will depend entirely on the kind of fuel used. Ordinarily it should not be necessary to clean out the spark trap more often than once each 60 days. This is done by attaching a wire or chain to the trap doors on the bottom of the arrester, the lower end of chain to be fastened at some point ouside the house within easy reach. By permitting the doors to jar heavily on closing, practically all trapped material will be shaken down and permitted to pass out to the wind. If the spark trap is not cleaned periodically, the gas opening in the arrester will gradually choke, causing the stove to smoke.

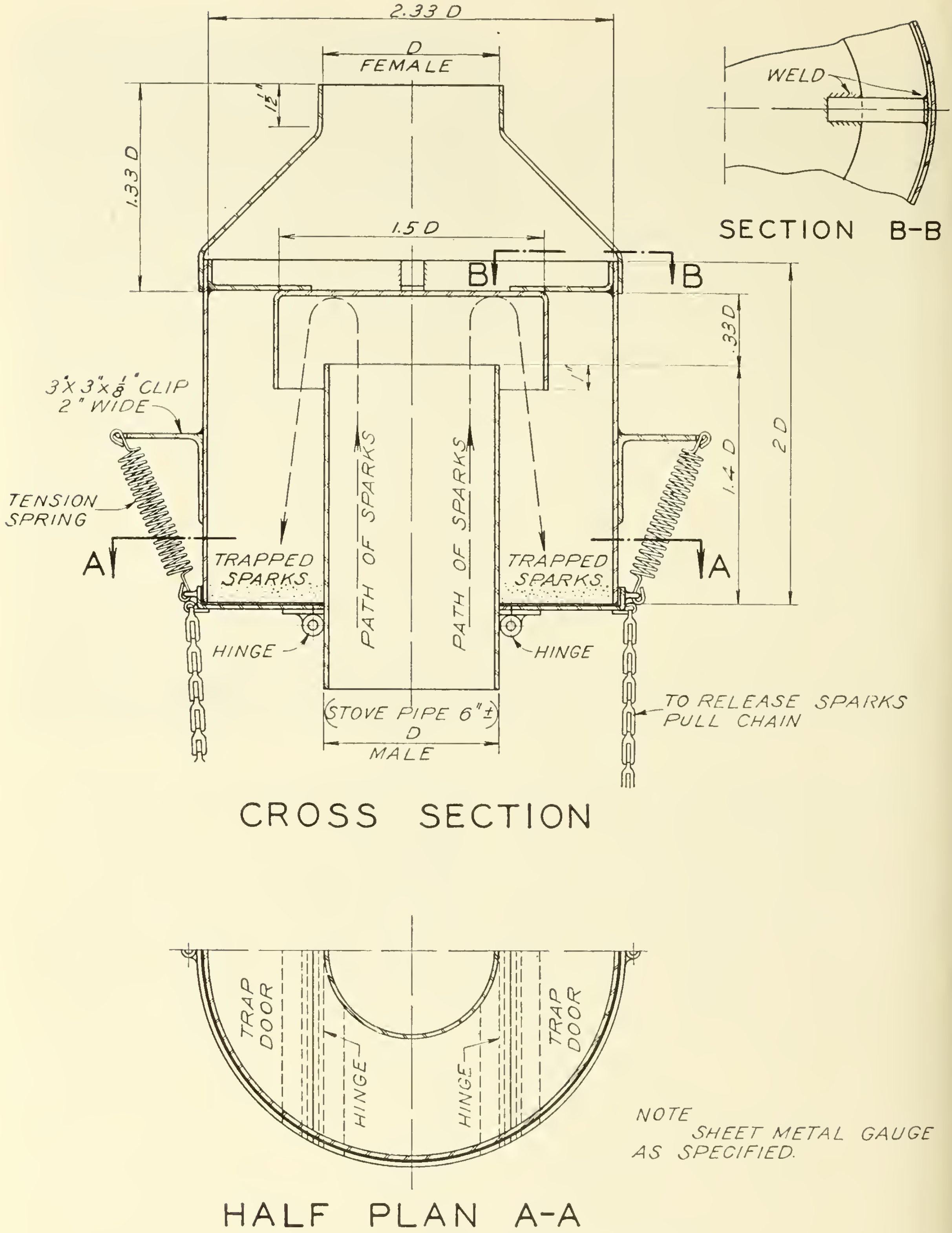


Sparks of a size which will almost invariably start a fire if permitted to land on inflammable material.

As to material, little need be suggested. Individual preference can have full sway. If the arrester is at least 22 feet removed from the stove on a flue having at least one elbow, a galvanized iron arrester will give good service for many years. If the flue is straight, there should be at least 30 feet between stove and the galvanized arrester if it is to stand up for any length of time. Black copper bearing iron will probably be used for most installations even though rust from the arrester streaks the stack. Cadmium plate might be substituted for the galvanized iron under similar conditions.

Metal gage will, of course, depend on the size of the arrester, amount of heat to which it will be subjected, as well as numerous other influences. For the average installation where it is expected to secure at least 10 years of service, arresters up to 8 inches in size should be of not less than 24-gage metal. Larger sizes should be proportionately heavier to secure strength as well as weight of metal.

No tests have been made of rectangular flues, but it is believed that if at least one round section of standard length pipe is used before the gas enters the arrester, no turbulence will result which will reduce the efficiency of the arrester.



Region Five Dwelling Spark Arrester

The arrester as designed has a streamlined cap with a female end on top so that it can be installed at any point in the flue. This cap is not necessary to the efficiency of the arrester, but it does prevent accumulations of wind-borne litter in the arrester. Drainage of water in the arrester is automatically provided by the loose-fitting trap doors. It might be desirable in some localities to install a cap over the arrester to prevent snow clogging. Any type of cap can be used as long as it does not restrict the flow of gas from the stack.

OCCURRENCE OF MAN-CAUSED FIRES ON SUNDAYS AND HOLIDAYS VERSUS WEEKDAYS IN THE NORTH PACIFIC REGION

John C. Wilkinson

Pacific Northwest Forest Experiment Station, Portland, Oreg.

In fire-prevention work, fire-danger rating, and other phases of fire control, it is important to know whether chance of man-caused fires is greater on Sundays and holidays than on other days. The wide variation in opinion among forest officers indicates the need of studying this subject. Herein are made available some facts about fire occurrence as related to days of the week and holidays and different causes and classes of people, obtained from a study of the fire reports made at the Pacific Northwest Forest and Range Experiment Station.

All man-caused fires on all the national forests in Washington and Oregon from May to October, inclusive, and for the years 1931–38, inclusive, were tabulated by day of the week or holiday on which they occurred and by different causes and classes of people. Hunters' fires were broken down into fires occurring during the day before plus the first 2 days of the legal hunting season and fires occurring during the succeeding days of the season. The original tabulations were made by forests, groups of forests, and months, but the most reliable comparisons come from the summaries prepared for the entire region and for the entire period.

Out of the total of 5,717 man-caused fires studied for the 8-year period, 1,091 fires occurred on Sundays, compared to an average of 771 fires per day on the other days of the week. There was a total of 4,115 smoker and camper fires, and of these 891 occurred on Sundays and only 537 per day on other days of the week. This shows that here were about 1.7 times as many fires per day on Sundays as on weekdays and indicates the magnitude of the fire load on Sundays as compared to other days. The Fourth of July and Labor Day appeared to have about the same rate of occurrence as Sundays, but Memorial Day and the opening days of the hunting season did not appear to have a higher rate than other days.

Since the number of people in the forests is much greater on Sundays and holidays than on other days, full credit should be given to prevention measures for keeping the number of fires on the days of heaviest use so nearly on the same level as on the days of ordinary use. Thus the relationship between prevention and fire occurrence, whatever it may be, is an important consideration to be kept in mind when interpreting the results of this study. The fire reports offer the only measure of occurrence, but they record the fires that happened in spite of prevention. There is no way of predicting what the fire-occurrence rate would be with more or with less prevention.

Looking at individual causes and classes of people responsible, it s apparent that smoker-fisherman and camper-fisherman fires show the strongest tendency to be concentrated on Sundays, and this seemed to be true in all parts of the region. This tendency is strongest early in the season. Debris-burning fires of the bonfire and trash-burning type (but not including land-clearing fires), smoker or camper fires attributed to travelers, hunters, and berry pickers, and camper-stockman and camper-rancher fires were found to have a slight tendency to occur most frequently on Sunday; but smoker or camper fires started by miners, and land-clearing, railroad, and miscellaneous fires seem to occur at about the same average rate on all days of the week. Lumbering and incendiary fires show a slight decrease on Sunday.

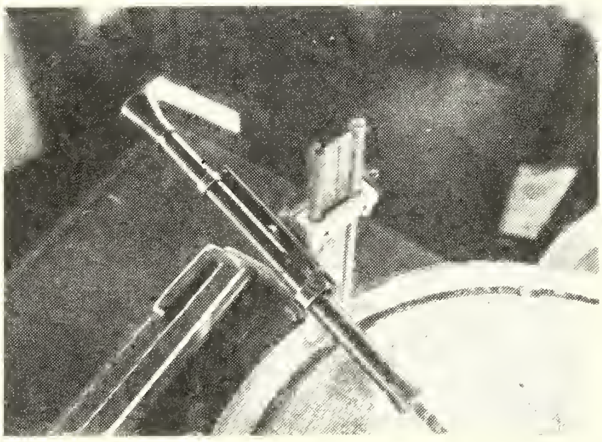
Although this study indicates that Sundays, the Fourth of July, and Labor Day have a somewhat higher occurrence rate than ordinary days, nevertheless the maximum number of fires to be expected on any one ranger district even on a Sunday or these holidays seldom exceeds 1 or 2 (as many as 5 man-caused fires have occurred in 1 day on 1 ranger district, but this is very exceptional), as compared to lightning storms, which commonly start 10 or 20, or more, fires on 1 district in 1 day. All things considered, it appears that the increase in man-caused fire occurrence on Sundays and holidays can be taken care of by the protection force required for other days of similar burning conditions (fuel, moisture, wind, and herbaceous stage) and visibility conditions. There may be a few localized exceptions to this statement, as on districts having the heaviest load of Sunday visitors or Sunday fires. Possibly the most important way to use the results of this study will be as a guide in determining where, when, and to whom additional prevention measures should be applied.

TELESCOPIC SIGHTS FOR LOOKOUTS

Karl E. Moessner

Junior Forester, Superior National Forest, Region 9, U. S. Forest Service

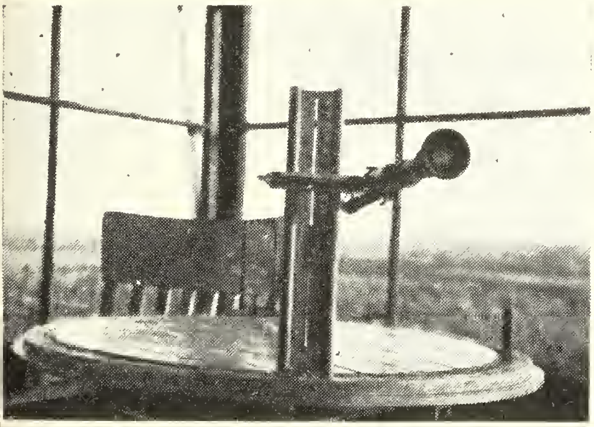
Telescopic rifle sights, mounted on standard Osborne fire finders, were tried out during the last field season by three Superior Forest lookouts and appeared to have marked advantages over the customary open sights.



Top view of scope, mounted on fire finder by means of trial wooden mounting.

The illustrations with this article show the manner of attaching the telescope to the rear posts of the fire finder by a simple mounting which allows sighting on near or distant smokes and holds the scope in a vertical position when not in use.

By adjusting the micrometer screws while sighting at a distant object the telescope is made to parallel the line of the open sights, facilitating instant use of either scope or peep. This alternate use nullifies any disadvantage which might be experienced because of the somewhat smaller field or the magnification of smoke or haze.



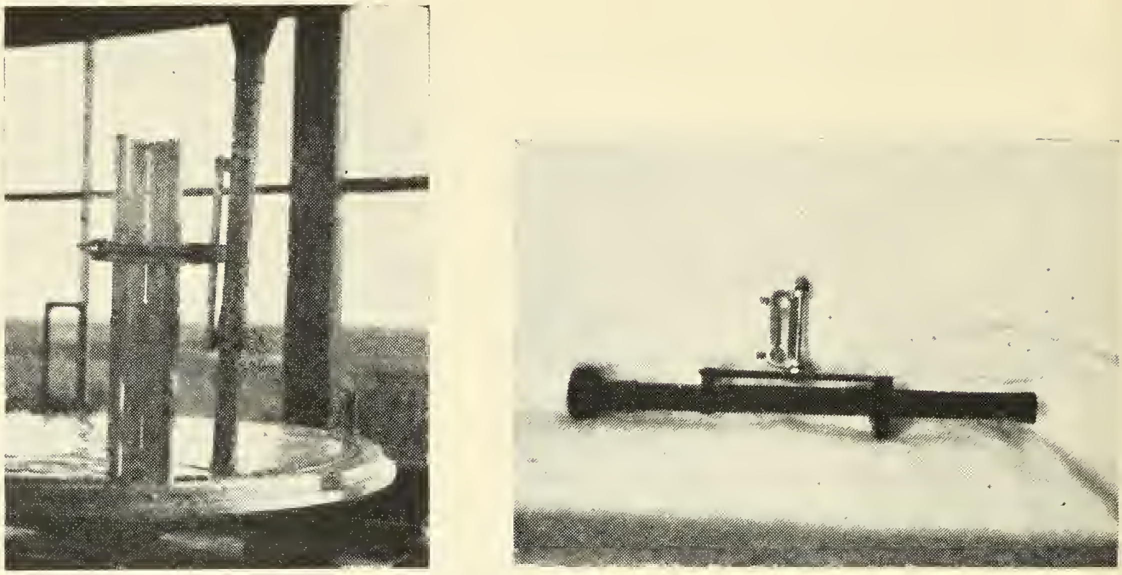
Scope on fire finder ready for use.

Although the manner of mounting prevents use of the scope when reading vertical angles, this proves of little importance in nonmountainous regions.

A few advantages credited to the improved sight are:

1. Horizontal readings to small or distant smokes are made with greater accuracy in much less time.
2. Estimates of the size of small fires are more accurate, since the sight makes reading both edges of the smoke column entirely feasible.
3. Locations of one-shot fires are more accurate, since the sight brings out folds in the terrain and details of cover invisible to the naked eye, yet requisite to careful estimates.

Although it has many of the advantages usually associated with binoculars the sight is relatively inexpensive. Satisfactory four-power scopes are available at less than $5, while the mounting, as finally designed, can be constructed of bronze for a few cents.



Left: Scope in rest position, vertical and out of the way. Right: Bronze mounting as finally designed. Note that the normal sight is unobstructed.

The 20-Hour Day.—In a recent issue of Fire Control Notes it was remarked that 10 hours should be the maximum number per day on fire fighting. Most of us, remembering the custom of the past, and the instructions of the present, say at first glance: "It is impossible to divide the day up in such a way."

This set-up, however, ties in with a system we have used whenever a fire arrives on the patrol, and mop-up basis, in the following manner: The day crew gets up at 6 a. m. and is on the fire line at 7 or 8 a. m. The night crew gets into camp at 9 or 10 a. m. They "try" to get in 4 or 6 hours sleep (slumber, in this case, versus ants, big, little and small, flies, heat, dust, the power grinder, public address system, and stories told by the forest officers called for in the "perfect camp set-up") before they are called for supper at 4 p. m. They are then out on the line by 6 p. m. so that the day crew can return to camp before dark. (Already I can hear protests from the experts.) The night crew gets in several good hours mopping up before midnight. They eat their lunch and fall asleep shortly after. Here is where the boss says: "Well boys, you can sleep from now until 4 a. m. if at that time you get up and hit the ball until the day crew arrives." (This legalizes the sleep they will take anyhow.) By this time, the fires in small materials have died out, the snags have cooled down and can be felled during daylight hours, with men who are refreshed.

The day crew gets a fair night's sleep, and instead of being tired and sleepy by noon, they are able to be alert when they are needed most, and fresh enough to tackle a break if one should occur.

During the night, naturally, it will be necessary to have a few good men to patrol on underslung line and where snags are apt to fall.

In this way, we can cut the day to 20 hours of work. There will still be some overlapping of time, because of travel time.

We know that the method described works with good results, since we have used it numerous times, and compared the results with those obtained on forests where they still believe in awakening the day crew at 3 a. m., when the fire is on a patrol basis.

This same system works well on a cold trail job. In fact, both night and day crews can be used, if conditions warrant, during the "golden hours of fire fighting."—Edward G. Madsen, *forest ranger, Sierra National Forest, Region 5, U. S. Forest Service.*

LESSONS FROM LARGER FIRES OF 1939 IN THE NORTH CENTRAL REGION

Clark—Jake Fire—340 acres.—Suppression action was satisfactory. Therefore the important task is that of prevention. Although fires set for the purpose of burning over lands, not owned by the person who sets the fire, are classified as incendiary, the fact that these may be set for a purpose which the individual feels is justified makes the prevention problem far different from those where fires are set with purely malicious intent.

There is need for constant effort on the part of the ranger and other regular forest officers to prevent this type of fire. This must be attacked indirectly so as to secure for the Forest Service the good will and confidence of the individual. In many cases a direct approach may antagonize.—Paul D. Kelleter, *forest supervisor.*

Clark—Malice Fire—548 acres.—The fact that this fire was discovered by a patrol unit and suppression was begun immediately further confirms the use of such units, particularly during periods of high danger and low visibility. Had there been no patrol unit and additional stand-by units available, the burned area would very probably have exceeded 1,200 acres.

The same comments in regard to fire prevention apply in this case as those given in the statements concerning the Jake fire.—Paul D. Kelleter, *forest supervisor.*

Clark—Dandy Fire—1,042 acres.—Even though the suppression of this fire was well executed, the need for a better scouting method was evidenced. With numerous sets scattered for 2 to 3 miles and burning conditions such as to cause very rapid spread, it is necessary to have a scouting system which uses the nearest observation points for obtaining information, with radio communication to the fire headquarters.

An intensive patrol for periods of high fire danger during bad fire weather and low visibility might have resulted in an earlier discovery of this fire.

Again the matter of fire prevention is emphasized. Our past programs have resulted in bringing the reasons for and benefits from preventing forest fires to the attention of probably every forest resident. An important method of attacking the prevention of this type of fire is through the continued efforts of rangers and other regular Forest Service personnel. This will likely best be done in a very indirect manner; the various forms of timber use offer a facilitating means for such efforts.—Paul D. Kelleter, *forest supervisor.*

Manistee—Northridge Fire No. 1—358 acres.—(This smoker fire was one-tenth of an acre in size when discovered, eight-tenths of an acre and spreading slowly in grass, leaves, and slash when first reached by 5 men, 53 minutes after known time of origin. Discovery time 14 minutes. Report time 11 minutes. Get-away 3 minutes.

Travel time, 7 miles by truck, 24 minutes. Travel delayed by road barricaded by deadfalls, fence, and trees, because of a local row. Wind of 4–7 miles upon arrival soon went gusty and changeable. Notes by foremen show 10 major wind changes. One drove fire directly at tanker when motor was stopped while district ranger was out directing crew. This run covered 600 feet in 2 minutes, damaging tanker and severely burning district ranger who could not start tanker motor.—Ed.)

One lesson learned from this fire is that additional stand-by fire equipment is necessary if we are to meet our fire suppression standards. The most urgently needed item is tanker trucks. * * * In this case, too much reliance was undoubtedly placed on the tanker truck based on our successes with it on about 40 previous fires.— E. S. Iversen, *district ranger.*

Experience had taught that in this particular set of circumstances the most urgent need was speed of effective attack. The most useful suppression instrument available was a three-quarter-ton tank truck equipped with radio. The development of this tank truck was so recent that only the district ranger possessed, at the moment the fire broke out, sufficient knowledge and skill to make the most effective use of the machine. Since speed was so important, the ranger, therefore, made the best use of the machine he could, believing it to be more effective than the larger crew of men which might have been mobilized in a little longer time.

The actual result was that the shifting character of the wind neutralized to a great extent the effectiveness of the tanker which was eventually put out of commission by being partially burned. The ranger was severely burned and put out of commission at the same time. As a result, the other features of the fire suppression suffered through lack of the ranger's skilled supervision.

The principal lesson to be learned is that the tanker should be in charge of a guard or someone other than the ranger, who has been highly trained and is skilled in its use, so that the man who is the logical fire boss will not have his attention absorbed in any piece of machinery. A further factor in the loss of time was the fact that the roads leading to the fire were blocked at the points where they crossed private lands. This situation has been known for some time and efforts been taken to correct it, but the fact that it has not been corrected and the resultant loss of time have certainly resulted in an unnecessary burning of a number of acres.—Quoted from supervisor's memorandum by G. K. Fenger, *acting regional forester.*

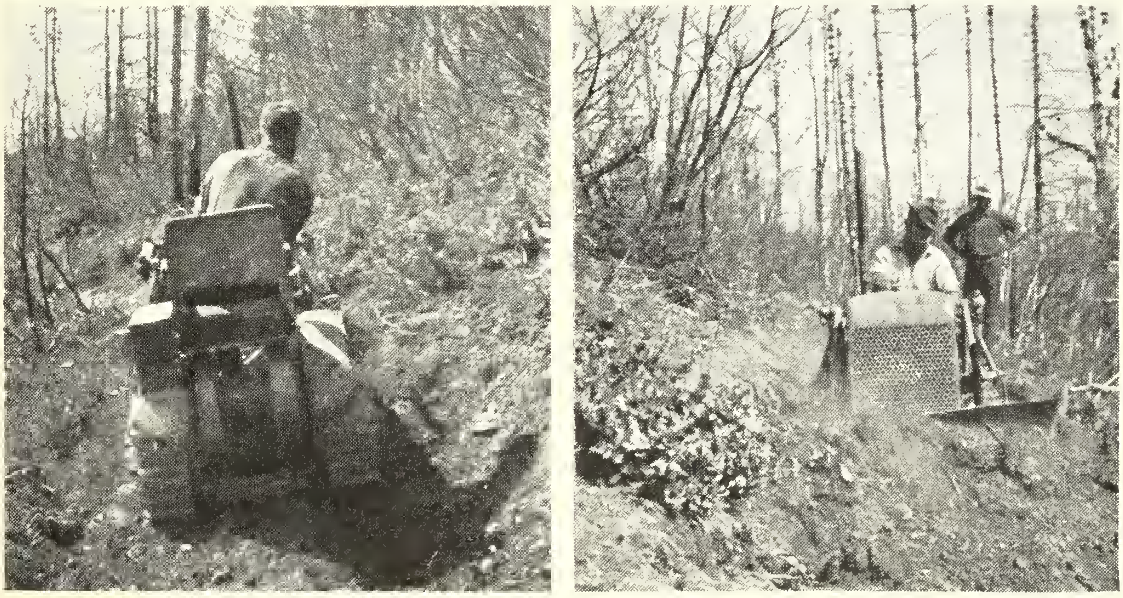
TRAIL TRACTOR AND TRAILMOBILE

THOMAS A. RICE
Division of Engineering, Region 6, U. S. Forest Service

The Trail Tractor

The trail tractor was developed in the Forest Service Experimental Equipment Laboratory at Portland during 1937 and 1938, primarily for the purpose of reducing trail-construction costs. The experimental model was used on trail construction on the Willamette National Forest during 1938 with satisfactory results, both as regards work accomplished and testing of the machine itself.

On the basis of the 1938 tests, five additional tractors were built for Region 6 during the winter of 1938–39, one for Region 4, one for the State of Washington, and two for the British Columbia Forest Service, a total of nine. One weakness in the rear-end assembly was brought to light in these machines during 1939, and was fully corrected in September and October 1939 by replacements in all units put out to date. The Canadian tractors were tied up early in the season because of the war. The Region 4 machine, it is understood, was used mainly on terracing work. The Region 6 units were placed on three west-side forests to determine what they could do under moderate to severe conditions of side slope, rock, and clearing.



Trail tractor in action.

The data on the following pages have been compiled from reports submitted by the Siskiyou, Umpqua, and Willamette National Forests.[1]

Specifications U. S. F. S. Special Trail Tractor

Detail:

Drawbar horsepower	19.0
Drawbar pounds pull, level, first gear	5,000
Drawbar pounds pull, level, second gear	2,640
Drawbar pounds pull, level, third gear	1,445
Drawbar pounds pull, level, fourth gear	855
Belt horsepower	22.5
Bore and stroke, inches	3¼ by 4
Number of cylinders	4
Revolutions per minute	1,500
Piston displacement, cubic inches	133
Speeds, miles per hour, first gear, forward	1.35
Speeds, miles per hour, second gear, forward	2.56
Speeds, miles per hour, third gear, forward	4.66
Speeds, miles per hour, fourth gear, forward	7.9
Speeds, miles per hour, first gear, reverse	1.56
Speeds, miles per hour, second gear, reverse	2.98
Speeds, miles per hour, third gear, reverse	5.45
Speeds, miles per hour, fourth gear, reverse	8.35
Number of lower track wheels each side	6
Track shoe length, center to center pins, inches	3.075
Track shoe width, inches	7½
Length track on ground, inches	52½
Total ground contact area, square inches	788
Width over all, inches	36⅛
Under height, inches	44
Clearance with grousers, inches	5
Center to center track (gage), inches	28⅝
Ground pressure, pounds per square inch bare tractor	3.59
Rear power take-off, revolutions per minute, first gear, forward	161
Rear power take-off, revolutions per minute, second gear, forward	307
Rear power take-off, revolutions per minute, third gear, forward	560
Rear power take-off, revolutions per minute, fourth gear, forward	950
Rear power take-off, revolutions per minute, first gear, reverse	187
Rear power take-off, revolutions per minute, second gear, reverse	357
Rear power take-off, revolutions per minute, third gear, reverse	651
Rear power take-off, revolutions per minute, fourth gear, reverse	1,000
Weight in pounds, bare tractor	2,830
Weight in pounds, with bulldozer	3,650
Weight in pounds, with bulldozer and hoist	3,970

Attachments available:

- 2-way hydraulic bulldozer with convertible blade.
- 4-speed reversible drum hoist with maximum 10,000 pounds line pull in low speed.
- 100-gallon per minute high-pressure water pump can be attached in place of hoist.
- 2-wheel trailer carts of 1,500-pound capacity trailed from drawbar.
- Trencher plow, pulled from drawbar.

Costs:

- Bare tractor in lots of 5, $1,700; lots of 10, $1,600.
- Tractor with bulldozer, in lots of 5, $2,350; lots of 10, $2,200.
- Tractor with bulldozer and hoist, in lots of 5, $2,650; lots of 10, $2,475.

Because of special reversible clutch and special power take-off, the cost of bare tractor is a little greater than Cletrac's small model, but when U. S. F. S. machine is equipped with bulldozer, the combined cost is less than any commercial model.

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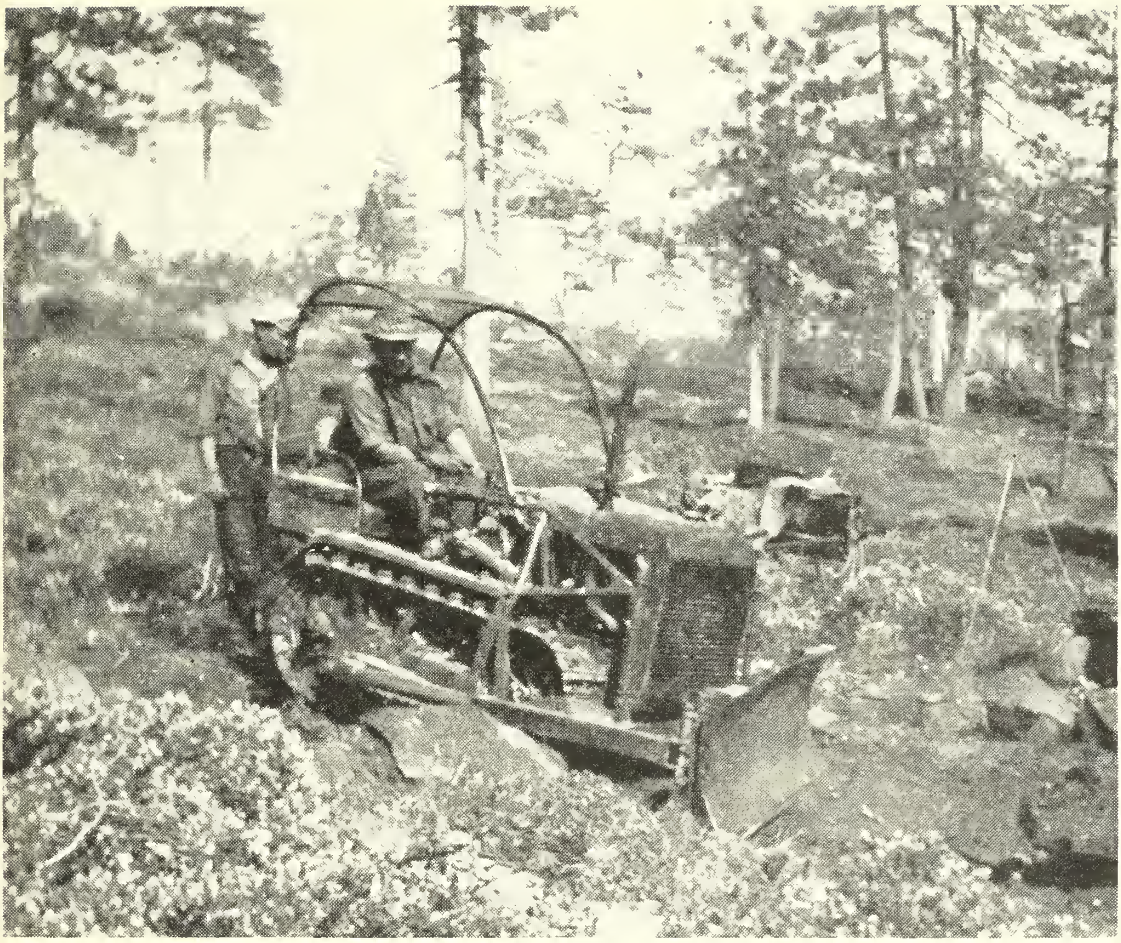
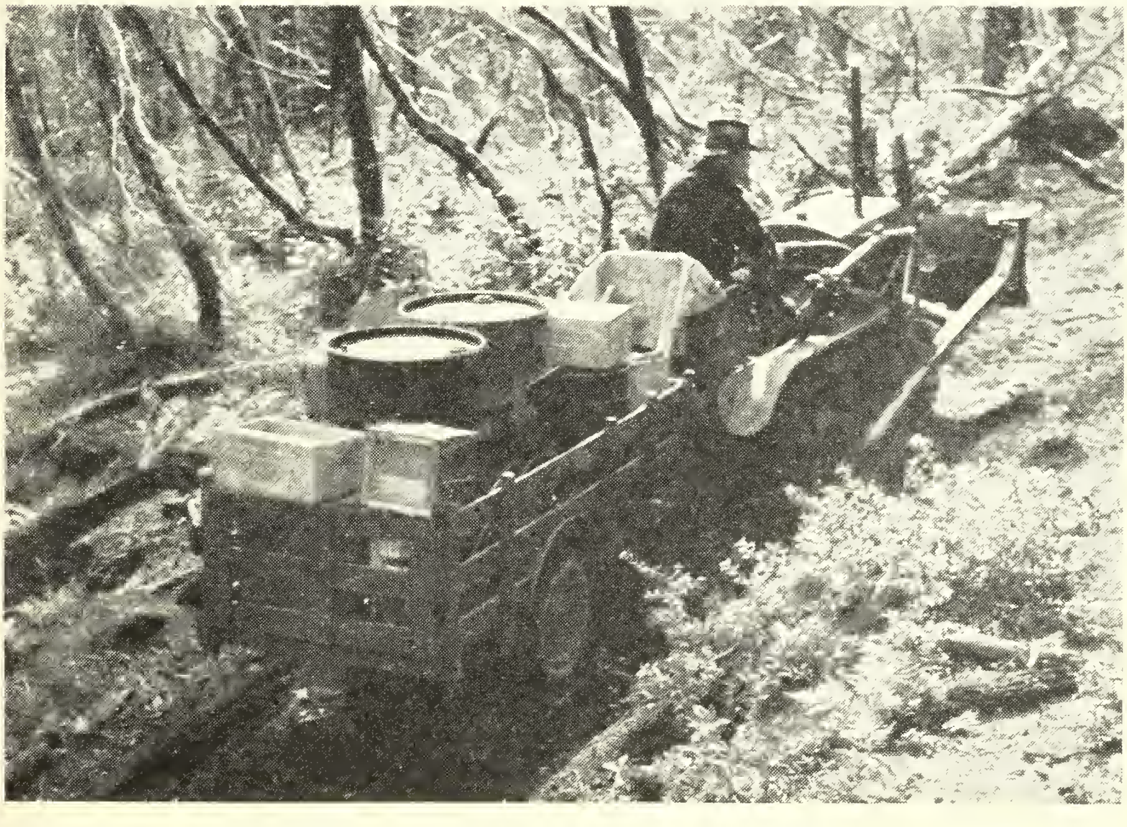
[1] The region is indebted to the supervisor, forest engineer, and field organizations of the three forests for excellent work on the job, good cost figures, photographs, and write-ups of their 1939 trail tractor projects.



Side view of trail tractor



Transportation of supplies by the trail tractor with trailer. Travel time of this outfit when loaded was approximately 4 miles per hour, and of course reduced the working time of the trail tractor accordingly.

SUMMARY

A summarized statement of tractor trail constructed during calendar year 1939 is as follows:

Forest	Project	Miles constructed	Average cost per mile	Estimated cost per mile for secondary trail using hand labor
Siskiyou	Chetco Divide:			
	Page district	4. 88	$493. 85	$600
	Chetco district	5. 77	417. 00	500
Umpqua	Red Butte	4. 50	238. 04	350
Willamette	Scar Mountain	2. 33	443. 77	550
Total		17. 48	362. 16	495

It is estimated that trail construction by hand methods in similar country on the Siskiyou approximates $600 per mile. The trail tractor average for the 10.65 miles of trail construction was $455 per mile. These costs can be expected to be reduced by better organization, the use of the trailmobile for transportation, and as experience is gained from operations.

Trail constructed by trail tractor.

Another trail constructed by trail tractor.

The Trailmobile

As trail-tractor operations advanced, the question of hauling supplies for machine and camp by other means than a trailer hitched to the trail machine, or pack stock, became important. A vehicle with gage to operate on the trails as constructed, with power and speed sufficient to transport the loads was needed to relieve the trail tractor from hauling supplies and permit it to follow the more important grading and construction work.

As an experiment, the construction of a miniature automobile fashioned after a pick-up or stake truck was undertaken.

The finished vehicle has specifications as below:

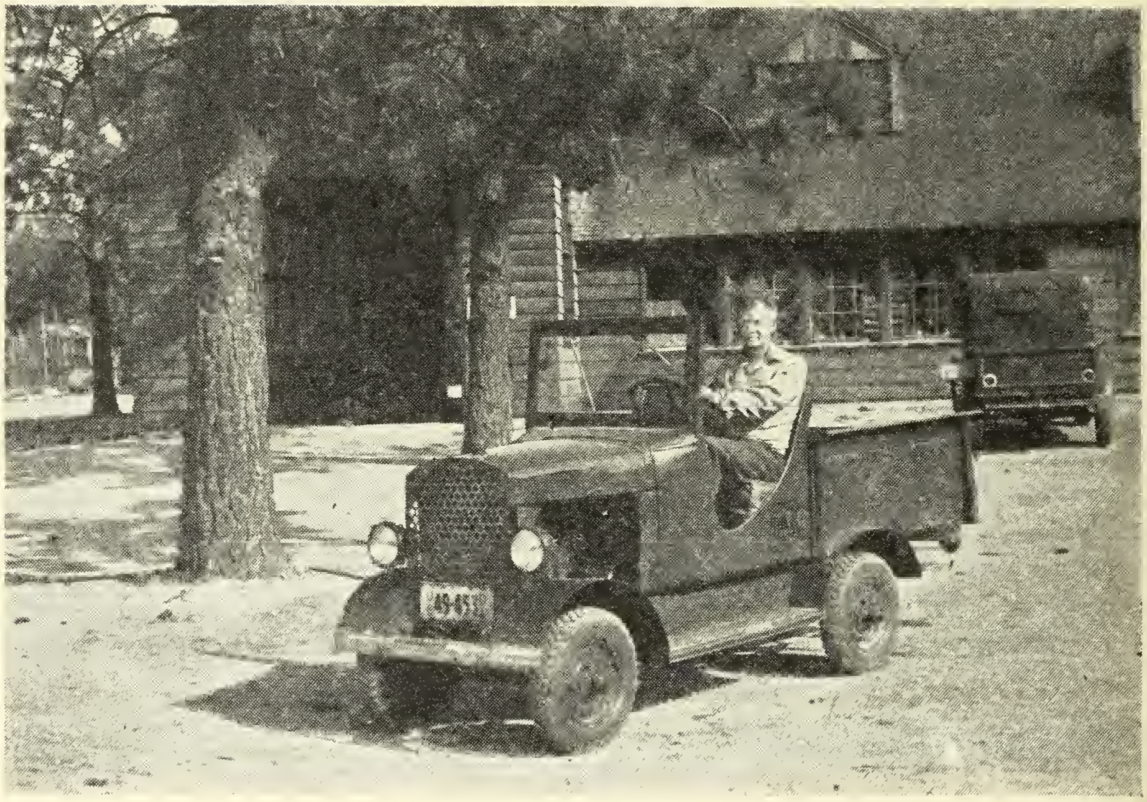
Motor, four-cylinder Hercules 1 XB.
Wheelbase, 60 inches.
Tread, 35 inches.
Weight, 1,400 pounds.
Minimum turning radius, 17 feet.
Top speed, 30 miles per hour.
Bed of box, 36 by 53 by 15 inches.
Load capacity, approximately 2,000 pounds.
Tires, outside diameter 20 inches, mounted on 4.50 by 12 rims.

Salvaged parts from a model A pick-up were used in the onstruction.

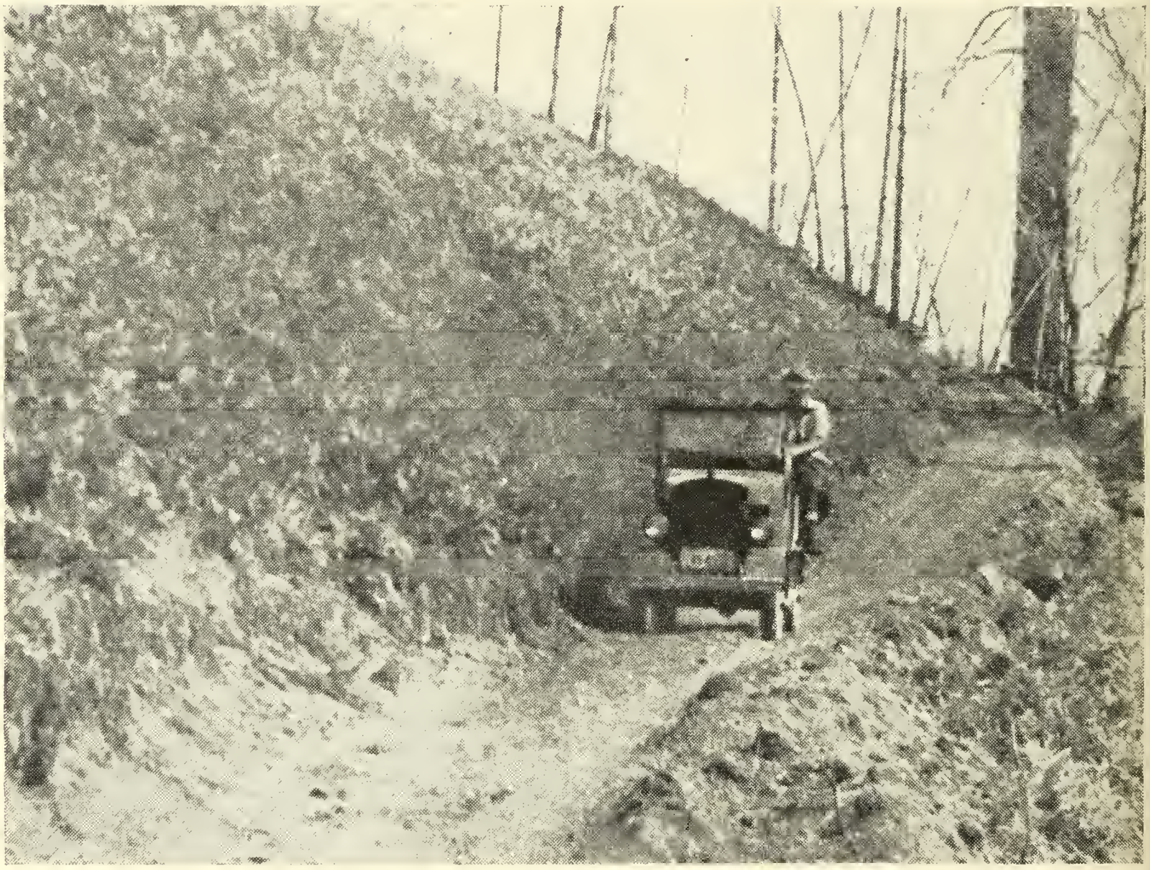
The cost of the trailmobile, using salvaged items, new motor, and abor is estimated as $569.

Comments from the supervisor as to the machine's value and omparative capacity follow:

> The trailmobile was put into service too late to allow time for development f records.



The trailmobile.



Trailmobile transporting supplies on completed trail.

Its capacity is equal to a seven-horse pack string, and it can maintain a hauling speed of 8 miles per hour. Estimated that hauling costs should not exceed 5 cents per ton mile, while like costs with the trailer-tractor combination are estimated as 18 cents per ton mile and pack-string costs approximately $1.50 per ton mile.

This machine was developed entirely by the personnel of the Siskiyou National Forest under the supervision of Supervisor E. P. Cliff.

CONCLUSIONS

The work done in 1939 brought out the following points:

1. The trail tractor is a workable and economical tool for trail construction. Although further refinements are possible (and probable), it may be considered as out of the experimental stage.

2. Trail can be economically built by machine on side slopes to 80 percent, with considerable ledge rock and boulders, heavy timber, and dense brush. The use of more powder than used originally in loosening rock and heavy stumps was found to speed up progress and reduce costs.

3. A trail tread of 58 inches after machine work, shrinking to approximately 54 inches after 1 year's settlement, is secured with the trail tractor. In Region 6 this is not objectionable from the maintenance standpoint.

4. Costs are lower than for hand work on standard secondary trails.

5. After tractor trail is completed, transportation of fire and other supplies can be accomplished at considerably lower cost by use of either the trail tractor with trailer carts or the trailmobile, than by pack stock. The trail tractor can pull two trailer carts with a pay load of up to 3,000 pounds at speeds of 3 to 5 miles per hour. The trailmobile can haul a pay load of 1,200 pounds at 6 to 8 miles per hour. A reasonably smooth trail grade is necessary, which presupposes annual blade maintenance.

olume 4 Number 3

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

*

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The value of this publication will be determined by what Forest Service officers, State forestry workers, and private operators contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire-fighting methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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RGANIZING NATIVES TO FUNCTION AS FIRE-FIGHTING UNITS USING THE 10- TO 15-FOOT METHOD

HENRY C. HULETT

Fire Control Assistant, White Mountain National Forest, Region 7, U. S. Forest Service

The extensive areas of tangled heavy fuels left in the wake of the New England hurricane of September 1938 presented a fire-control problem of great proportions. Realizing that previously used methods of line construction would be of no avail, the forest officers of the White Mountain National Forest set about the development of a new method suited to the unusual situation. The method and its development through the period of training local crews is a fine example of creative effort.

Within a month after the 1938 hurricane, reconnaissance was rted and every available man in the region took part. After eral weeks of this work it was estimated that more than 50 percent the timber on 150,000 acres was piled up on the ground in jackaw fashion from 5 to 25 feet deep.

During the 10 years preceding the hurricane, the fire record on the ite Mountain National Forest showed an average of only five fires year, with a total annual loss of less than 2 acres. In this time with this record the local people and the forest officers naturally ame extremely optimistic. There was a feeling that the horrifying days of the 90's (when 5,000- to 20,000-acre fires commonly burned several parts of New Hampshire simultaneously) had vanished ever.

All this was changed overnight. Stories of the past became street ner gossip wherever two or more lovers of the forests got together. the face of the crisis the local population was ready and willing to to almost any length to avert a parallel or repetition of those ner disastrous conflagrations. Since the days when the smoke of ging fires darkened the New Hampshire sun, her people have ned what the scenic beauty of their forested mountains and the ie of the few remaining timber operations actually mean to them, the possibility of this precious beauty and wood supply being ied out overnight in another holocaust of flame and smoke was alling.

rganization and training of fire crews was begun to meet the new ation. Crew organizations averaged about 135 men, but varied n 90 to 175 men. Varying the size of the crews did not materially down production per man hour. Fire training required approxiely 6,850 man days. Included in the training program were 850 l people; 120 forest officers, guards, and CCC camp overhead; and 2 CCC enrollees. In total, in the course of the 1939 fire season, 15 local and 18 CCC special fire schools were held. The schools include the entire personnel normally needed in the suppression of a moderate sized fire. The largest unit included approximately the followin organization:

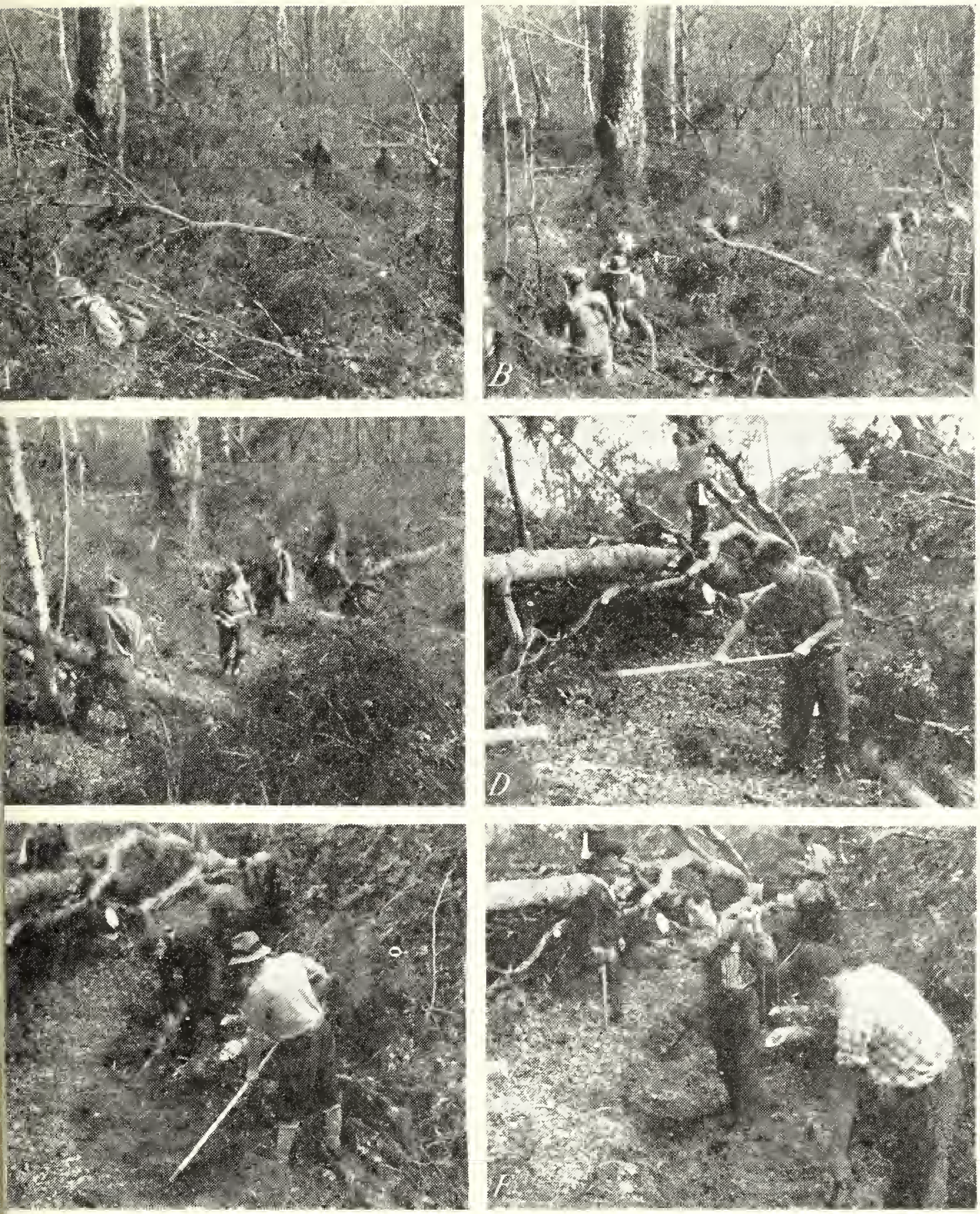
Fire boss and assistant	2
Head scout and 3 assistants	4
Clearing foreman and assistant (4 sections)	2
Crew leaders	4
Crew laborers	40
Digging foreman and assistant (5 sections)	2
Crew leaders	5
Crew laborers	50
Patrol and mop-up foreman and assistant (3 sections)	2
Crew leaders	3
Crew laborers	30
Communication boss and crew (telephone and radio)	5
Water boys (1 per section)	12
Camp organization (timekeepers, property clerks, packers, etc.)	14
	175

Overhead includes all those not directly connected with either th clearing, digging, or patrol and mop-up crews. The smaller unit were very much like this 175-man unit except that they had a proportionately smaller number of sections in the various crews and i the number of overhead.

To those accustomed to working in light fuel only occasionall intermingled with short streches of heavy fuel the overhead liste may seem top heavy. But schools conducted on the White Mountain National Forest were almost exclusively confined to fuel types uniformly heavy throughout. The safety of the men must be constantl watched while they are in these heavy fuels. The men once on th fire line were spread over a distance varying from 1,200 to 1,800 feet A spread such as this in any type of fuel is dangerous and needs extr overhead to reduce the danger of trapping those out in front. Fue types encountered are illustrated in A on page 103 and A, E, and I on page 105.

The three crews (clearing, digging, and patrol and mop-up) of th unit worked as individual groups; that is, the clearing crew advance as fast as it could, not waiting for the digging crew to keep pace Often this caused an opening of as much as 5 chains between th last man on the clearing crew and the first man in the digging crew These openings in the line usually occurred when the heavy fue thinned out momentarily. The gaps never lasted long because, generally, the diggers were pressing or occasionally working into the rea of the clearing crew.

The patrol and mop-up crew served as a digging crew until eac member was assigned to his 3-chain patrol beat. Additional patrolmen (besides those available from the three 10-man sections) whe needed, were available from three sources: (1) the digging crew; (2 the clearing crew (with tools brought in by camp packers); or (3) by doubling the distance each man of the first patrol section patrolled and thus relieving one patrol section for moving forward. The latte source was used only when the patrol work slackened. Foreman and crew leaders on the patrol and mop-up crew were utilized to watch for and direct action on spot fires within easy discovery distance o the fire line.



ring and digging crews working in medium to heavy hardwood-conifer fuel
pes: Clearing crew—*A*, Line locator advancing into medium fuel type; *B*,
st section of choppers in clearing crew have cut line through; *C*, last section
choppers. Line ready for digging crew. Digging crew—*D*, Line clearing
mpleted. Lead-off man in digging crew marking dug line location; *E*, con-
tion of dug line after two raker sections had passed by; *F*, end of digging
ew. Line ready for backfiring or line firing and patrol.

he number of scouts listed in the 175-man unit holds for all units.
y were necessary in order to obtain the best location for the line.
uts were seldom able to see, because of heavy brush, more than
o 30 feet ahead at any one time, and for this reason at least three
were required to locate the line of least resistance fast enough to
ahead of the clearing crew. Advance scouting in extremely
vy fuel type materially helps to reduce the amount of clearing
ssary. Fire-line locations used in the schools did not always
r on the *best* line location for two reasons: (1) the desire to give
training crews as tough going as possible, and (2) the inexperience
he scouts in avoiding tough going in the extremely heavy fuels.

As line-location work eased off, because of less fuel, the excess scou were used in checking for possible spot fires at greater distances ba of the line than normally would be covered by the members of t patrol and mop-up crew.

The training of natives to function as organized fire-fighting un is accepted as a desirable Service-wide practice. The one-lick meth is an excellent way to increase line production and to keep the spi and morale of the fire fighters at a high pitch at all times. The 10- 15-foot method used in the schools described in this articles differs on slightly from the one-lick method. It was developed to cope wi the extremely heavy fuels encountered in a blowdown area.

The heavy fuels encountered, including both slash and duff, nece sitated a man working in place and taking several licks rather th just one or two licks and then stepping ahead as practiced in the on lick method. To regulate the forward speed of the men in the 10- 15-foot method, the men were instructed to work continuously they proceeded, taking as many licks as possible, but never getti closer than 10 feet to or more than 15 feet back of the man ahea A 5-foot space was thus provided for each man to work intensive whenever a hold-up prevented forward progress.

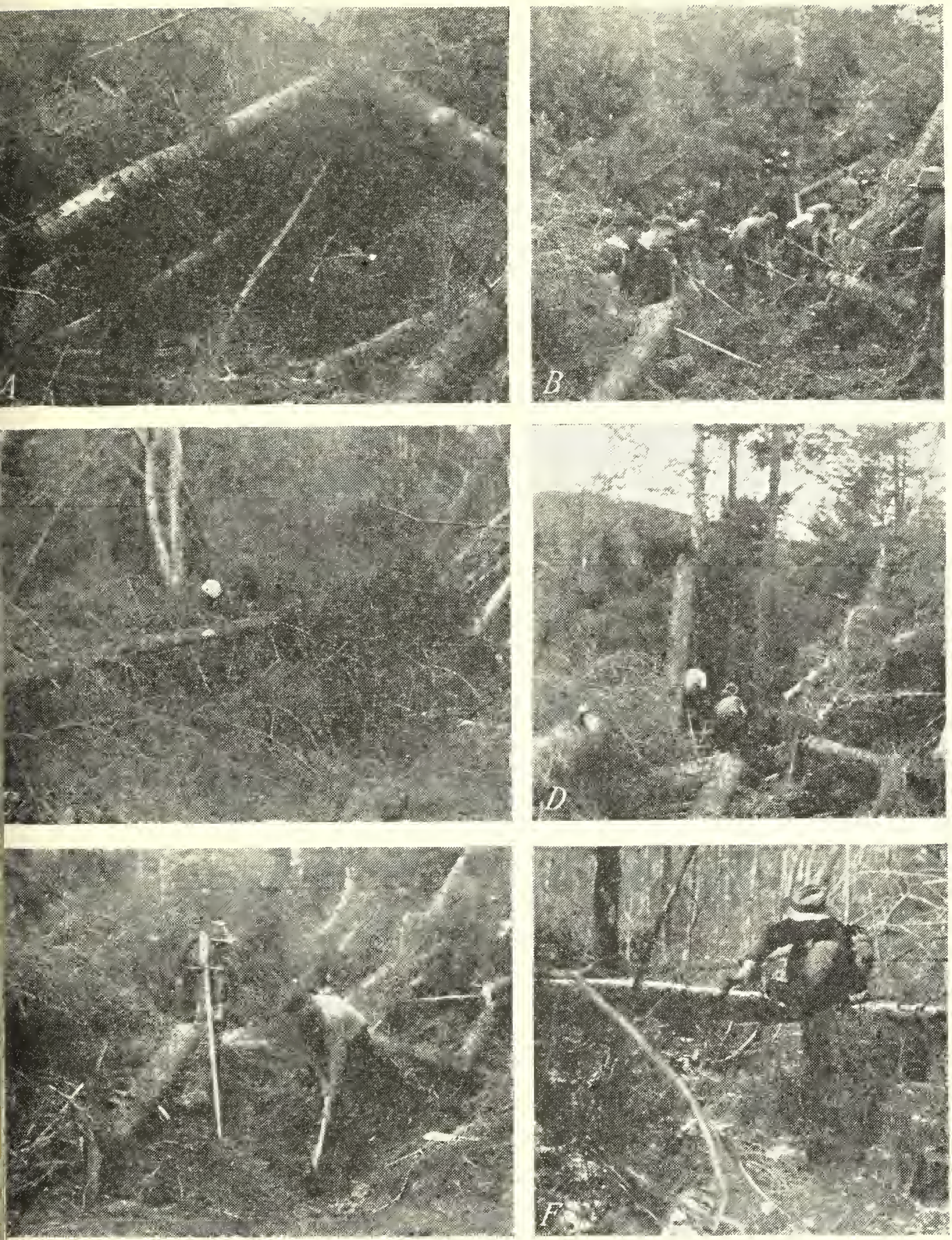
Following is a further breakdown of each crew in the unit and son of the difficulties and problems encountered with the crews at th various schools. It is hoped that this will clarify some of the problen and show the advantages and need of training natives into organiz fire-fighting units.

Clearing.—The secret of speed in line construction rests almost e tirely on spacing the men at the stipulated 10- to 15-foot distanc and knowing when and how fast to push forward the lead man in th line. During the first schools the first men in the clearing crew had tendency to go too fast and leave too much work for the last men the crew. As a result a part of the clearing crew had to hold back complete the work and this in turn held up the entire digging crew.

Elimination of this difficulty was accomplished by assigning assis ant foremen to the clearing and digging crews. One foreman wou stay at the head of the line to judge the situation and set the pace f the clearing and digging crews so as not to leave more work than th men toward the end of the line could handle.

Often, when the clearing was extremely heavy, the chopping cou best be handled by advancing all choppers at a rapid rate of spee until the last chopper entered the thicket and then let each man wor in place until the line was chopped through. The men would the move ahead again at a rapid pace and continue the same operatio until the fuel type thinned out to permit more steady advancemen In other words, the choppers would work at a fast and slow rhythı The advantage of a lead of five chains or more over the diggers becan apparent when the clearing crew was confronted with extreme heavy slash. This lead often allowed the clearing crew to work the way through the tough going before the digging crew could catc up and close the gap.

As in most clearing crews, the saw teams worked independently each other and did not attempt to keep in the rhythmic swing of th rest of the clearing crew. Two methods of distribution were tried an both seemed to be effective; one was to include one or two saw team



l types and fire-line construction on the White Mountain National Forest: , Heavy conifer fuel type. Scouts have nicked logs; *B*, first five men of digging ew raking heavy top-duff with council tools. Rakers will work into clearing am left to clean up leaving conifers; *C*, advance scouting in medium heavy nifer-hardwood fuel type; *D*, clearing crew has cut line through and is now orking on snags and Pulaski-tool crew coming up will remove rotten stumps d roots; *E*, line completed with patrolmen digging out rotten spruce root, ake set to end of patrol beat; *F*, line locator in light conifer-hardwood fuel pe.

part of each 10-man chopping section; the other was to follow the pping section with a 10- or 14-man saw section.

he last section of the clearing crew was made up of 10 men with aski tools. The principal job for this section was to finish off the ring job and place the line in shape for the diggers. When no ring was needed above ground, they devoted their time to chopping out dead roots and obstacles which would hold up the rakers at head of the digging crew.

The two following clearing-crew organizations seemed to funct equally well. Set-up No. 1, however, was used on most of the trials

Set-up No. 1:
- 1 Foreman.
- 1 Assistant foreman.

1. Crew leader and 10 men.
   - 10 Axes.
   - 1 Brush hook.
2. Crew leader and 10 men.
   - 10 Axes.
   - 1 Brush hook.
3. Crew leader and 12 men.
   - 4 C C saws and axes.
   - 2 Pulp saws and axes.
   - 2 Peaveys.
   - 1 Pole ax.
4. Crew leader and 10 men.
   - 1 Pole ax.
   - 10 Pulaski tools.

Total, 48 men.

Set-up No. 2:
- 1 Foreman.
- 1 Assistant foreman.

1. Crew leader and 10 men.
   - 1 Brush hook.
   - 7 Axes.
   - 1 C C Saw, peavey and ax.
   - 1 Pulp saw and ax.
2. Crew leader and 10 men.
   - 1 Brush hook.
   - 7 Axes.
   - 1 C C saw, peavy and ax.
   - 1 Pulp saw and ax.
3. Crew leader and 10 men.
   - 5 Axes.
   - 2 C C Saws and axes.
   - 2 Peaveys.
4. Crew leader and 10 men.
   - 1 Pole ax.
   - 10 Pulaski tools.

Total, 46 men.

Pictures A, B, and C on page 103 and B on page 105 show clearing crew in action.

Digging.—The digging crew is much easier to control as to spaci and forward progress than the clearing crew. This is true becaus defined area has been laid out in which the men in the digging crew w work. Many of the obstacles that impaired the rhythm of the cle ing crew have been removed. The men in line have less difficul keeping the regulated 10- to 15-foot spacing. Consequently, less lo time or unnecessary work resulting in decreased production, experienced.

The ganging up of the men or too great a spread reduces the e ciency of the operation. But, on the other hand, when the m spread out more than 15 feet apart, they have a tendency to wa ahead spasmodically, instead of gradually working ahead, th passing over and leaving weak sections in the line. The gaps in t line usually are caused by a slow worker who is unable to mainta the pace of the others in the line. When this slow worker is told catch up and close the gap, his tendency is to walk forward and car his tool. When he does this, each man behind him immediate follows suit and walks forward without working. Such irregulariti while susceptible to all crews, are more common with the diggi crew. Usually they occur during the first hour on the job. Aft that, the crews develop a steady speed and rhythmically move forwa

The organizational set-up of the digging crew consists of two 1 man sections, equipped with light digging tools used chiefly to remo the upper layers of duff. These are followed by three 10-man se tions equipped with heavy digging tools capable of completing t line to a point where it could be backfired, condition permitting, a mopped up or patrolled by the patrol and mop-up crew which follo on the heels of the digging crew.

The light digging tools used in New England are chiefly coun tools. The heavy digging tools are pulaski tools, hazel hoes, and tocks. The distribution of the men and tools in the average-size ging crew follows:

reman.

ssistant foreman.

rew leader and 10 men.
  1 Pulaski tool.
  10 Council tools.

rew leader and 10 men.
  1 Pulaski tool.
  10 Council tools.

3. Crew leader and 10 men.
   1 Pole ax.
   2 Pulaski tools.
   4 Hazel hoes.
   3 Ax mattocks.
   1 Council tool.
4. Crew leader and 10 men.
   (Same as under No. 3.)
5. Crew leader and 10 men.
   (Same as under No. 3.)

Total 57 men.

he assistant foreman was added to the digging crew to (1) provide necessary close supervision to work effectively so many men along ne varying from 500 to 750 feet in length and normally traversing ged topography; (2) have a man at the head of the line capable udging the intensity of work to be performed by the head of the v in order to have the line completed when the last man in the crew ses over it; (3) provide a capable leader to assist in the backfiring; (4) have someone available to direct a small crew in controlling t fires without disturbing the forward progress of the main digging v.

he tools for each of the last three sections of the digging crew sists of the necessary equipment for controlling a small spot fire. several fires within the State during the 1939 season, it was noted t spot fires left uncontrolled were directly responsible for failure atch the fire during the first period, and that lack of adequate rhead resulted in failure of the fire fighters to attack and prevent e spot fires from getting out of control.

ictures D, E, F on page 103 and C on page 105 show the digging v in action.

atrol and mop-up.—The patrol and mop-up crew serves in various s, depending upon the conditions prevailing at the time the line nstructed:

Conditions permitting, they will function as a backfire or line- g crew improving dug line as they advance, dropping the patrol every three chains from the end of the crew. If employed at kfiring, they might not keep up with the digging crew. But, in firing, since the original line location would normally be danger- y exposed to the edge of the fire and would need constant patrolling would normally keep up with the rear end of the digging crew.

Where weather conditions are not favorable for backfiring or line g, the crew will work along as if a part of the digging crew. The man in the line is dropped off at three-chains intervals unless the type, necessity of line betterment, topography, degree to which has been exhausted, or a cold line dictates that a patrolman can tively handle more than three chains of fire line.

any of the conditions encountered on a real fire were difficult to across to the men in the patrol and mop-up crew during the rimental schools. We did find, however, that three chains was it the maximum length of line a patrolman could cover and im- e the line so as to provide a satisfactory break in the duff to ral soil.

Fire-line-construction tests held on White Mountain National Forest

Test 1939	Kind of crew	Number of men	Average time on the line	Man-hours without overhead	On job with overhead	Chains of line	Chains of line built per man-hour		Remarks
							Without overhead	With overhead	
A Aug. 12	Clearing	38	4 hours 26 minutes	168	211	111	0.660	0.526	Overhead consisted of 28 men as follows: Fire boss, assistant fire boss, 2 scouts, 14 water and equipment, 6 communication. and 3 camp overhead. Average travel 1 hour 14 minutes per man. Total manpower 146 (Androscoggin).
	Digging	45	4 hours 26 minutes	200	252	104	.520	.413	
	Mop-up and patrol	36	4 hours 26 minutes	160	201	104	.650	.517	
	Overhead	27	Entire organization		664	[1] 108		.163	
B Aug. 15	Clearing	60	4 hours 35 minutes	275	346	99	.360	.286	Overhead consisted of 31 men as follows: Fire boss, assistant fire boss, special messenger, 4 scouts, 12 water and equipment, 9 communication, 3 camp overhead. Average travel 1 hour 20 minutes per man. Total manpower 151 (Pemig).
	Digging	41	4 hours 35 minutes	188	236	79	.420	.334	
	Mop-up and patrol	19	4 hours 35 minutes	87	110	79	.909	.718	
	Overhead	31	Entire organization		692	[1] 87		.126	
C Aug. 21	Clearing	56	5 hours 15 minutes	294	380	129	.438	.340	Overhead consisted of 39 men as follows: Fire boss, assistant fire boss, 3 scouts, messenger, 22 water and equipment, 5 communication, and 6 camp overhead. Average travel 35 min. per man. Total manpower 174 (Ammonoosuc).
	Digging	45	5 hours 15 minutes	235	303	115	.489	.380	
	Mop-up and patrol	34	5 hours 15 minutes	178	229	109	.612	.476	
	Overhead	39	Entire organization		912	[1] 117		.128	
D Sept. 9	Clearing	39	5 hours 30 minutes	214	247	90	.420	.364	Overhead consisted of 20 men as follows: Fire boss, assistant fire boss, 4 scouts, 11 water and equipment, and 3 camp overhead. Average travel 1 hour per man. Total manpower 148 (Androscoggin).
	Digging	57	5 hours 30 minutes	313	383	113	.360	.295	
	Mop-up and patrol	32	5 hours 30 minutes	176	203	113	.641	.556	
	Overhead	20	Entire organization		833	[1] 100		.120	
E Sept. 16	Clearing	46	5 hours 32 minutes	254	312	141	.555	.452	Overhead consisted of 29 men as follows: Fire boss, assistant fire boss, 1 special messenger, 5 scouts, 9 water and equipment 8 communication, and 4 camp overhead. No travel time. Total manpower 156 (Pemig).
	Digging	46	5 hours 32 minutes	254	312	133	.524	.426	
	Mop-up and patrol	35	5 hours 32 minutes	193	237	133	.690	.561	
	Overhead	29	Entire organization		861	[1] 135		.157	
F Sept. 18	Clearing	45	5 hours 30 minutes	247	340	108	.437	.318	Overhead consisted of 34 men as follows: Fire boss, assistant fire boss, manager, 4 scouts, 17 water and equipment, 4 communication, and 6 camp overhead. Average travel 30 minutes per man. Total manpower 125 (Ammonoosuc).
	Digging	23	5 hours 30 minutes	126	173	77	.601	.445	
	Mop-up and patrol	23	5 hours 30 minutes	126	173	77	.601	.445	
	Overhead	34	Entire organization		686	[1] 90		.131	

Oct. 7	Mop-up and patrol	22	5 hours 40 minutes	125	155	95	.760	.613	Average travel 37 minutes per man. Total manpower 135 (Androscoggin).
	Overhead	26	Entire organization		765	[1] 105		.137	
H Oct. 18	Clearing	35	4 hours 30 minutes	157	194	85	.541	.438	Overhead consisted of 21 men as follows: Fire boss, assistant fire boss, special messenger, 4 scouts, 9 water and equipment, 3 communication, 2 camp overhead. Average travel 1 hour 20 minutes per man. Total manpower 116 (Pemig).
	Digging	35	4 hours 30 minutes	157	194	82	.522	.423	
	Mop-up and patrol	25	4 hours 30 minutes	112	138	82	.732	.594	
	Overhead	21	Entire organization		526	[1] 82		.156	
I Oct. 20	Clearing	45	5 hours	225	276	120	.533	.435	Overhead consisted of 23 men as follows: Fire boss, assistant fire boss, 3 scouts, 4 communication, 11 water and equipment, and 3 camp overhead. Average travel 1 hour per man. Total manpower 125 (Ammonooscu).
	Digging	34	5 hours	170	208	94	.553	.452	
	Mop-up and patrol	23	5 hours	115	141	94	.817	.666	
	Overhead	23	Entire organization		625	[1] 105		.168	
J Nov. 9 DCC	Clearing	57	5 hours 30 minutes	313	336	74	.236	.220	Overhead consisted of 9 men as follows: Fire boss, 2 scouts, 3 communication, 3 camp overhead. Average travel 1 hour 30 minutes per man. Total manpower 135 (Camp Gale River).
	Digging	35	5 hours 30 minutes	193	207	74	.384	.363	
	Mop-up and patrol	34	5 hours 30 minutes	187	200	74	.386	.370	
	Overhead	9	Entire organization		743	[1] 74		.099	

---

[1] Average.

The tool distribution is the same for each 10-man section of tl
patrol and mop-up crew. These sections are so equipped that th
may be readily shifted onto spot fires or sent back along the line
handle a dangerous area temporarily until reenforcements can arriv
Each man assigned to a section of line for patrol and mop-up duty
equipped with a light digging tool (council tool or shovel), a heav
digging tool (pulaski tool, hazel hoe, or ax mattock), a 5-gallon bac
pack pump, and lantern.

One man of each section packs the extra tools and equipmen
except the 5-gallon back-pack pumps, for his section. This man do
not work in the line while packing this equipment. Once in tl
vicinity of the area to be patrolled by his section, he caches his loa
and devotes his time to distributing the tools to the other membe
of the section and scouting for spot fires. All tools, except the heav
digging tools, are packed by regular packers and not left with tl
man until he is assigned a patrol beat.

The lanterns are placed one each at the termini of the patrol boat
The lanterns readily mark the limits of a patrol area at night and a
easily moved for increasing or decreasing the length of a patrol are
The back-pack pumps are brought in by a special pack crew workin
out of the fire camp. This same special crew may be assigned t
packing water to refill these back-pack pumps whenever water is n
readily available to the various sections of the line. The distributio
of the men and tools in the average-size patrol and mop-up crew wa
as follows:

1 Foreman.
1 Assistant foreman.
1. Crew leader and 10 men.
    1 Pole ax.
    5 Pulaski tools.
    5 Ax mattocks (or hazel hoes).
    5 Shovels.
    5 Council tools.
    10 Back-pack pumps.
    10 Lanterns.
2. Crew leader and 10 men.
    (Same as under No. 1.)
3. Crew leader and 10 men.
    (Same as under No. 1.)
    Total 35 men.

A patrolman near one termini of his beat and the condition of tl
line and type of fuel which requires not less than one man ever
three chains are shown in D on page 105.

From the tests carried on during the latter part of the 1939 fi
season, data have been computed and is shown in the table. Th
data present an excellent picture of what actually happened on th
ground and many interesting angles may be found in studying an
comparing the data on the different tests. Space does not permit th
full explanation of all the possible questions that arise in studyin
the table, but the following highlights may clear up some of the mos
obvious ones:

The line location for the various tests were all at widely differen
places on the forest. Test A was comparable in conditions to test
yet the number of sections per crew were different. The averages fo
chains of line built per man-hour on test E and test H were very nearl
the same, 0.157 and 0.156 chains per man-hour respectively, yet ther
were 40 more men on test E than on test H. The topography on tes
H was considered the toughest of all tests undertaken. The ratio

nanpower distribution by crews for these two tests is practically the same.

Test G also was located on a rough area with an exceptionally heavy fuel-type in which to build a fire line. Pictures A, B, C, and D on page 105 were taken on this line. The average for chains of line built per nan hour was nearly as good on this test as on test H, yet there were approximately 20 more men, besides every man worked, in all crews, an hour and 10 minutes longer than the men on test H. The entire complement of men on test G were completely exhausted at the end of 5 hours and 40 minutes of steady work. They were given only a 30-minute lunch period at noon, which made the only appreciable break in the day's work.

A point of interest disclosed is that the average time worked on the ine in the tests varied from 4 hours and 26 minutes, to 5 hours and 40 ninutes. The majority of the crews worked between 5 and 5½ hours on the line. All men were on the job 8 hours. This period covered he time the men were hired and names placed on the payroll at the ire camp until they signed their time slips and were discharged. Time not charged against line construction was utilized in hiring the nen, organizing crews, instructing the crew members in the 10- to 5-foot system of fire-line construction, instructing the men in the use of various types of tools, safety measures, travel to and from the fire-ine location, checking in all equipment, and signing time slips and ravel vouchers. Everything was carried on just as if an actual fire xisted.

The tests indicate that under normal conditions from ⅓ to ½ a hain of line per man-hour, in extremely heavy fuel-type and duff-over, can be cleared and dug for each hour the crews are actually on he job. This includes all overhead normally needed to safeguard he organization and carry on the job of fire suppression effectively. t is true that the tests were all undertaken during daylight hours and hat results obtained in 24-hour tests might show widely different esults. Night tests are planned during the 1940 season.

The training of natives as provided by the tests undertaken on the White Mountain National Forest during 1939 will not provide fire rews or units that can compete with or replace the need for highly rganized 40-, 50-, or 60-man fire-suppression crews that are regularly mployed primarily as fire-fighting units. However, highly organized rews are not as yet a Service-wide reality, and it is doubtful if they lone will ever be able to handle all types of fires that the Service nust contend with during the ensuing years. Organized natives are eeded in our fire organization as well as highly developed and trained egular fire-supression crews. It is certain that the 800 to 1,000 atives who were subjected, either directly or indirectly, to this systematic method of fire-line construction, have profited considerably nd will materially strengthen the fire organization on the White Mountain National Forest for a number of years to come.

COOPERATIVE FIRE PREVENTION

Paul K. Taylor

District Ranger, Wenatchee National Forest, Region 6, U. S. Forest Service

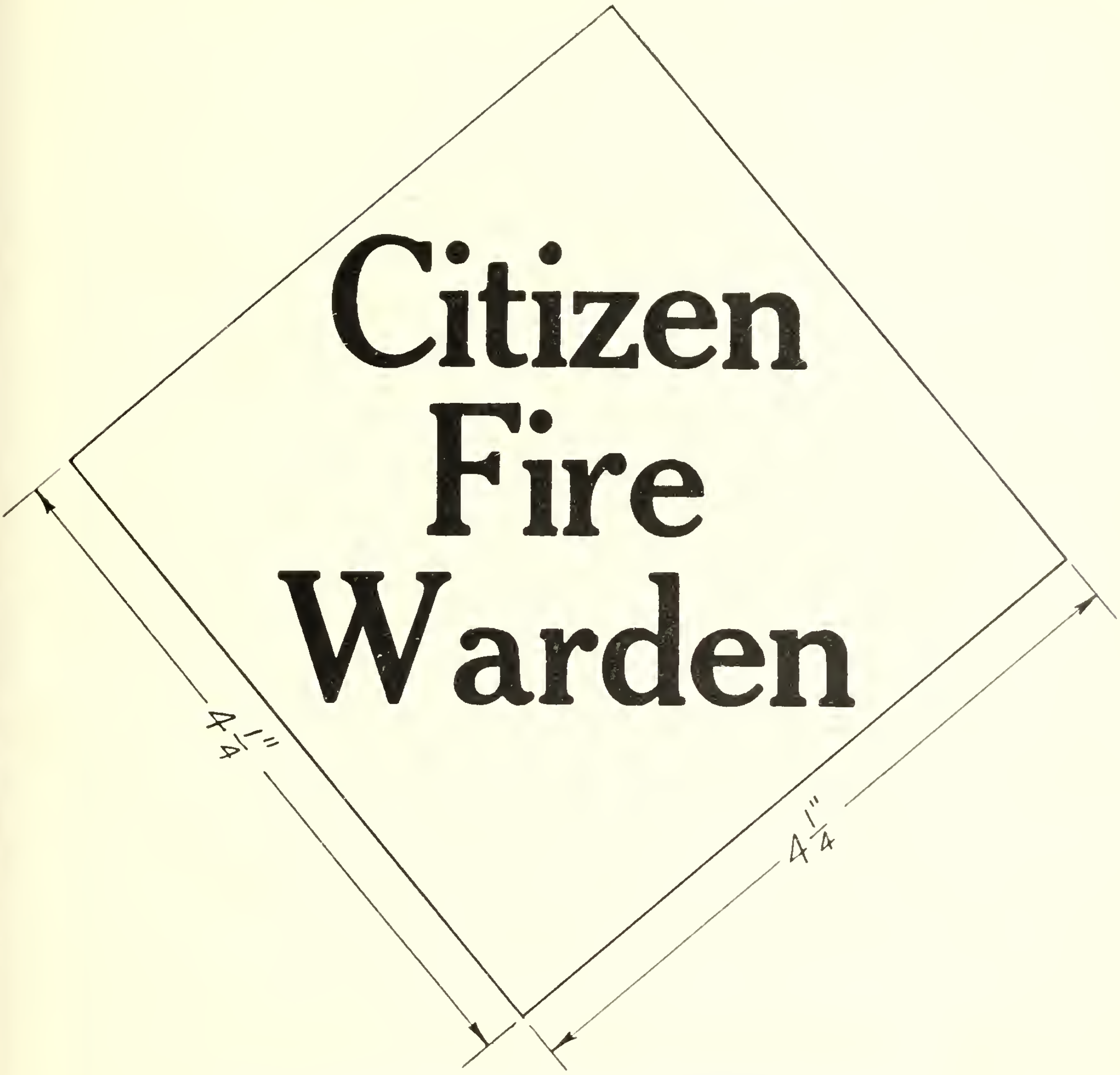
Fire prevention has been a plodding and not very imaginative member of the fire-control family. In this publication as in the whole field of fire control, far too little is contributed to this important subject—so the presentation of this new slant is most welcome.

An analysis of the man-caused fires on the Leavenworth Ranger District, Wenatchee National Forest, for the 1939 season up to July 10, showed that of 24 fires 70 percent were caused by smokers; of the total, 60 percent were charged to local residents. No particular class or group of people could be charged with the responsibility for setting the fires.

To meet this problem a meeting was called, comprised of four chamber of commerce presidents, one county commissoner, one major, one irrigation-district president, two prominent sportsmen, two editors, and a sergeant of the Washington State Highway Patrol. The matter was presented to the group by Fire Assistant Blair, who emphasized the fact that local people were causing most of the fires and that the community was dependent on the resources of the national forest for irrigation and domestic water, timber, and recreation. It was pointed out that under certain weather conditions a fire might easily wipe out a watershed upon which the surrounding communities depended for their water and timber supply and that the people residing within the community would be the greatest losers should this occur. Those present put the following program into action, based on the idea that in a fire-prevention program the force of public opinion should be brought to bear on the unthinking person who carelessly starts a fire:

1. A group of Citizen Fire Wardens was organized who served in a cooperative capacity, without reimbursement. These men were selected for their honesty and dependability. Any fire-law violation observed by the wardens was corrected on the ground if possible; if not, the violation was reported to the supervisor on a card designed for that purpose. A sticker as illustrated was printed in red lettering and paid for by the various chambers of commerce to be placed on the car driven by a Citizen Fire Warden.

Each warden was furnished with franked postcards on the reverse side of which was printed a "Report of Forest Fire Violations." Should he discover a fire-law violation, he would check which law was violated, where and when it occurred, and the license number of the car. Each warden was assigned a number to be used instead of his signature on the bottom of the card. On receipt of the card the supervisor wrote a letter to the offender calling attention to the violaion and asking his cooperation in the future in preventing fires. esult: Forest-using public, contacting a large number of Citizen ire Wardens, found they must be careful with fire, not only because iere was a law, but because responsible people just wouldn't put up ith carelessness.

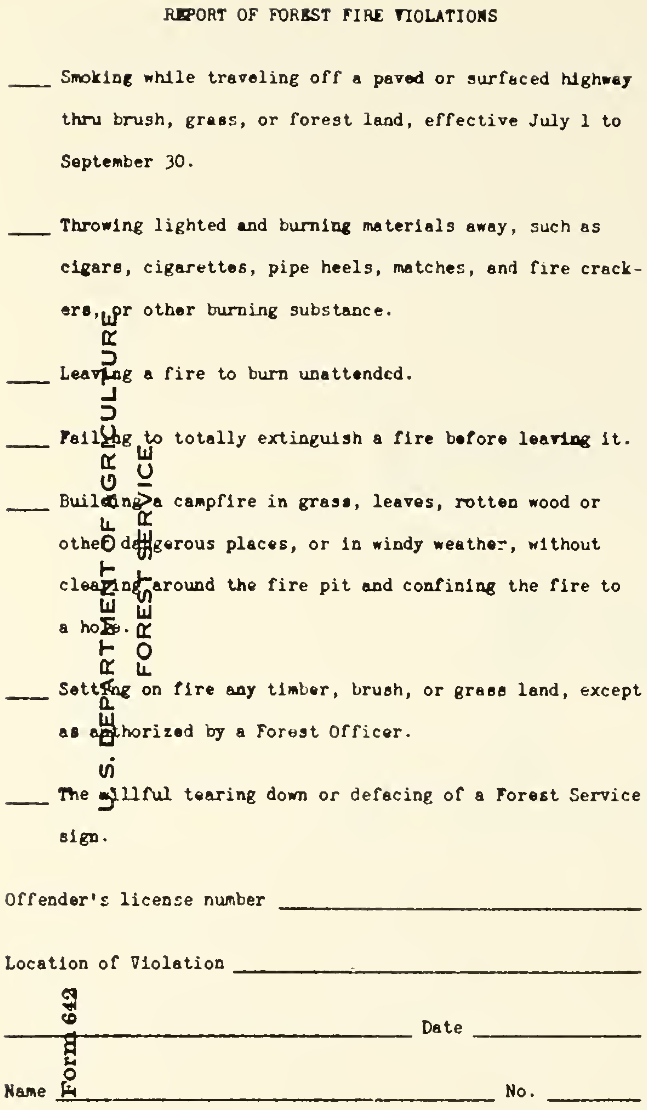


Car sticker used by the citizen fire wardens.

2. The editors responded with a series of news articles telling what as being done to curb man-caused fires; they also printed editorials. hese articles and editorials stressed the point that the general public, vic organizations, etc., were becoming alarmed about the great numer of man-caused fires, and passed out a warning to fire-law violators. he Forest Service was seldom mentioned. Results: Editorial coment stirred irrigationists, sportsmen, and recreationists to action. his was shown particularly by their efforts in cooperating with the orest Service in suppression of lightning fires occurring later in the ason.

3. The chambers of commerce sponsored a number of timely nnouncements from radio station KPQ at Wenatchee.

4. The State police cooperated fully. Each patrolman, acting in his ıpacity as a State officer, was empowered to make arrests for violaons of any State fire laws. In addition, they operated car-checking ations on the major highways. All cars passing through the forest a certain day were stopped, ash trays checked, and occupants



REPORT OF FOREST FIRE VIOLATIONS

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

___ Smoking while traveling off a paved or surfaced highway thru brush, grass, or forest land, effective July 1 to September 30.

___ Throwing lighted and burning materials away, such as cigars, cigarettes, pipe heels, matches, and fire crackers, or other burning substance.

___ Leaving a fire to burn unattended.

___ Failing to totally extinguish a fire before leaving it.

___ Building a campfire in grass, leaves, rotten wood or other dangerous places, or in windy weather, without clearing around the fire pit and confining the fire to a hole.

___ Setting on fire any timber, brush, or grass land, except as authorized by a Forest Officer.

___ The willful tearing down or defacing of a Forest Service sign.

Offender's license number ______________

Location of Violation ______________

______________ Date ______________

Form 642

Name ______________ No. ______

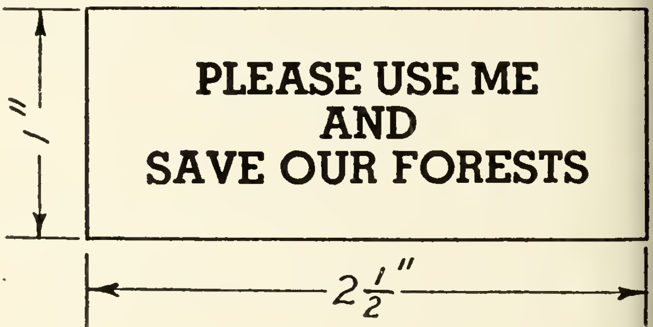
Post-card form for reporting forest-fire violations.

cautioned about throwing awa lighted material, leaving camp fires, etc. Results: Not a singl complaint from occupants c stopped cars; in fact, severa letters were received by th supervisor commending thi action.

5. The sheriff's office cooperated in the same manner a the State patrol, except tha they did not check cars.

6. Ash-tray stickers wer printed and paid for by th chambers of commerce in thi locality. Competent service station attendants were furnishe these stickers.

Service-station operator added ash-tray service to thei regular duties, which gave them an opening to place the sticke on or above the ash tray. Many times they were asked why they did this, which gave them an opportunity to talk fire prevention. Result: Tourists were impressed by this service and it gave a contact with people who otherwise could not have been reached.



Ash-tray sticker distributed by service-station attendants.

The plan was inaugurated about the middle of July and continued through the driest fire season known to the Wenatchee Forest which did not end until late in October. Material results were that only eight more fires were caused by man. Those who carried on the program have a much better idea of our problem. And, best of all, they have signified their willingness to put the same machinery into action again.

NEW AIR-COOLED ENGINE

H. M. White

Fire Control, Region 6, U. S. Forest Service

Mechanization is increasingly a factor in greater work production from suppression tools but with our peculiar problems portability is often a prerequisite to design of motorized equipment. This is particularly true of the power plant required for chain saws and trenchers and other small-scale mobile devices which may be evolved in the future. This article is a cheering progress report of the development of the air-cooled light engine.

In 1938 Ted Flynn, who is in charge of the Region 6 Forest Service quipment laboratory, suggested the possibility of air-cooling one of he small two-cycle Marine engines used on portable pumpers so that t could be used on light machines where water cooling is impracticable. The laboratory engineers had greatly improved the Stihl chain aw purchased for experimentation, but nothing could be done about he Stihl engine, which is much too heavy and has insufficient power. Region 1 engineers had developed the Bosworth trencher, and the ngine selected for it, while reasonably satisfactory, showed certain weaknesses.

Air-cooling a standard engine the efficiency of which had been roved seemed to be worth trying, and at the Washington meeting ast year the fire-control equipment committee agreed that an allotment for the purpose should be made from the all-Service equipment-evelopment fund.

After a thorough study of the principles of air-cooling, plans were rawn and an attempt was made to contract the construction of an xperimental engine. No bids were received. The engineers had owever, become so interested in the development that they were eager to do the construction work at the laboratory. Various makes f engines were investigated, and the Champion Senior Twin was elected. This engine has two cylinders, opposed, with piston dislacement of 12.46 cubic inches. Its rated horsepower is 6.6 at 4,000 p. m. as compared to 4.5 for the Bendix engine used on the Bosorth trencher. The crankshaft and bearings are considerably rger than those on the Bendix, the main bearing surface being 50 ercent larger.

To air cool the Champion engine new cylinders with cooling fins ere machined from solid steel blocks (S. A. E. 4140). The cylinder eads were cast from aluminum alloy and screwed to the steel cylinders hile the latter were packed in dry ice for maximum shrinkage. new fly wheel of the proper weight and with Bosch magneto asembly was purchased. The air fan and shroud were fabricated from uminum.

The engine has been completely assembled at much less cost than as anticipated. So far it has been run for short periods only, without load. It is now (April 10) being mounted on a base with a Pacific Marine pump, and in a few days a long test run will be started. Thi test under load at the laboratory will be continued until it is reasonabl certain that all weaknesses in design or construction have been discovered and corrected, after which the engine will be adapted to th Bosworth trencher and the chain saw and thoroughly tested in th field. Results of the tests and further engineering data will be mad available later.

It is not expected that this engine, which weighs only 34 pounds will develop sufficient power for the longer 6- to 7-foot saw blades but the power should be ample for the Bosworth trencher and chai saws with blades up to 5 feet in length. To keep weight to the minimum and still have plenty of power for the work to be performed it appears desirable to have two sizes of light engines. It is estimate that an engine similar to the Senior Twin with ample power for th longer saws and portable pumpers meeting the requirements of MSF-273 would weigh not to exceed 42 pounds.

Aerial Delivery of Hot Food on the Line.—Due to lack of trails, pack stoc had difficulty in supplying food. If it were not for the airplane service (two plane used on this fire) many men would have gone without food and beds. Cooke food was dropped from the plane. The forest reports the following results:

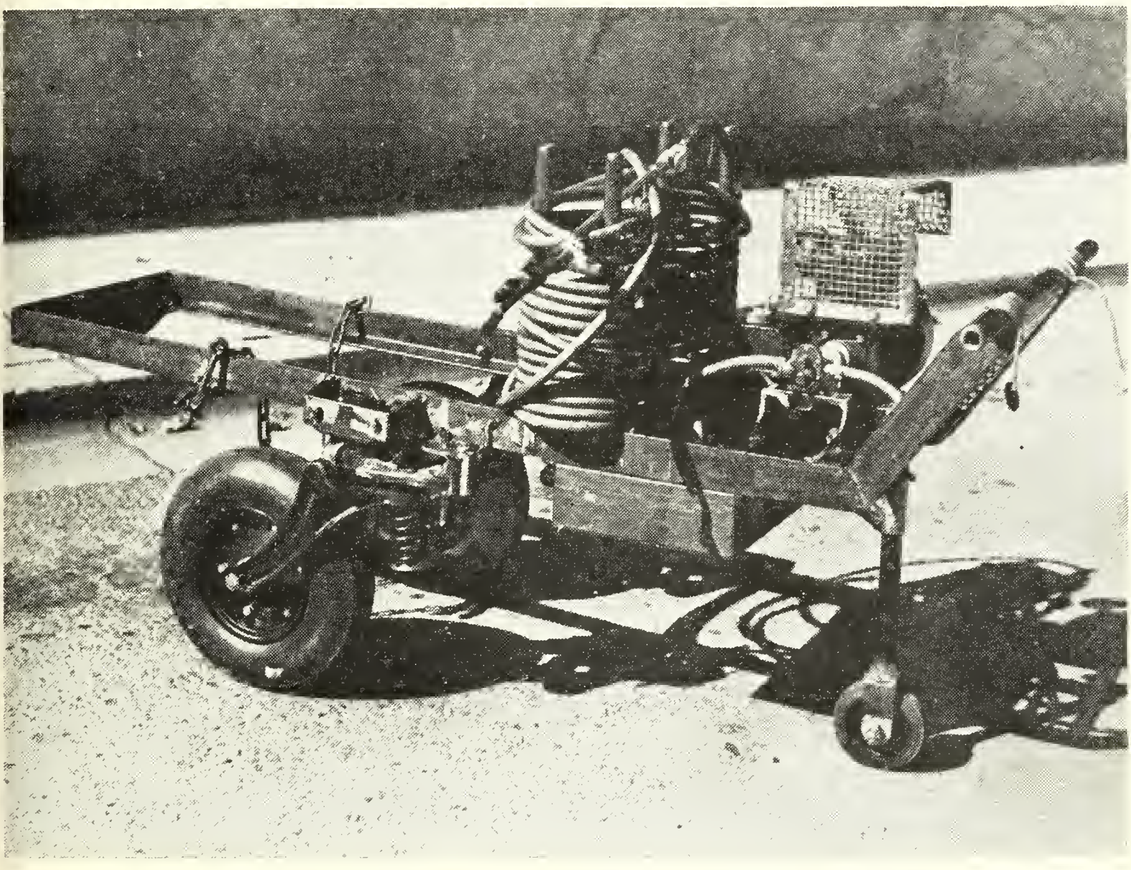
"Dropping hot cooked food by airplane was tried on this fire. Vegetable an meat stew, macaroni and cheese, bread, butter, and hot coffee were dropped o this fire the first day, and with great success. Fifty men were fed hot cooked foo as listed, dropped by one six-place airplane which came in under the smoke an dropped this food at a target which was placed where the base camp was late located. Hot coffee and other liquids were packed in 5-gallon tin cans, 2-inc screw tops, in pasteboard cartons, and wrapped in canvas. Paper plates an cups, and wood spoons and forks were used with the cooked food, and 10 gallon of coffee remained hot enough for use after being packaged 13 hours. Eac 5-gallon can was packaged and dropped with a wool sack 7 x 7-foot parachute but little damage was done to the cans, and no loss of food occurred. It is believed a breakage of cans can be entirely eliminated by the use of the ⅜ steel-strap packaging method as used commercially for cartons. Especially should this strap be applied around the 5-gallon can about one-third way up from the bottom. With a few other minor improvements this method of feeding fire fighters, especially in the first attack, is far superior to any other method we have used."—*Regio 4 report on the North Fork Stoddard Fire, Idaho National Forest, 1939.*

MOBILE FLAME THROWER

F. W. Funke

Specialist in Fire Control Equipment, Region 5, U. S. Forest Service

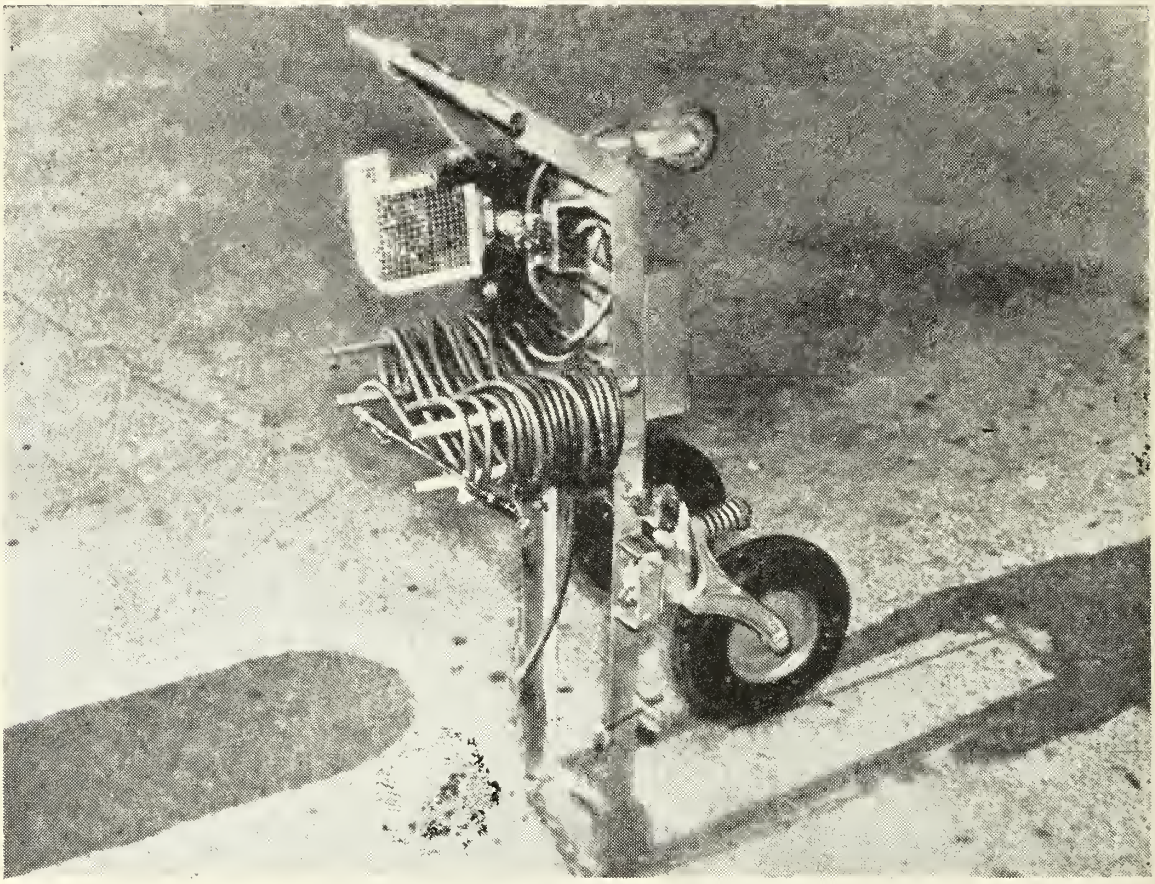
There has long been a need for a flame thrower device larger than the regular back-pack outfit. The standard portable back-pack outfit when used as a flame thrower serves a definite purpose, but because of the intermittent blast produced by the trombone pump it is im-



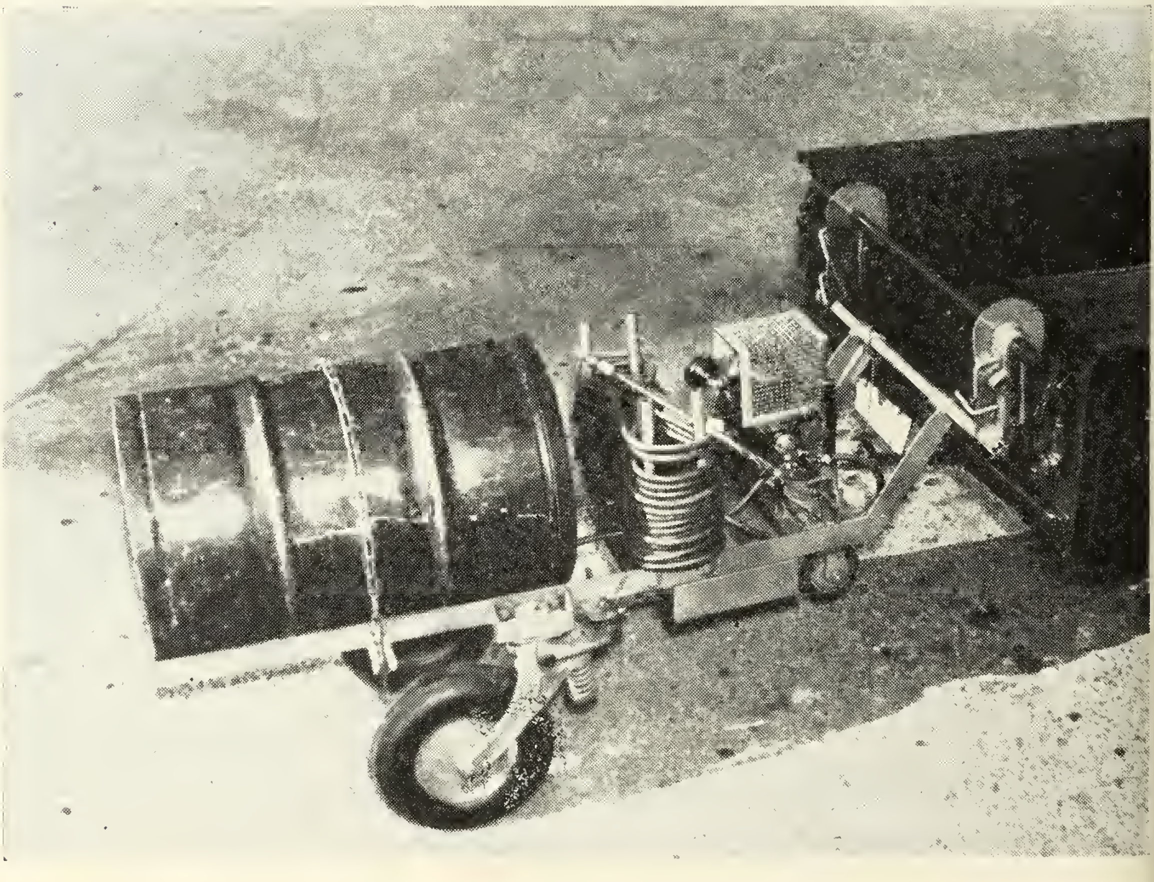
Flame thrower in position to load barrel.

ossible to develop the flame intensity desirable for defoliating jobs long roads or fire lines. There are many cases where it is necessary o produce an intense backfire along motorways, in order to generate eat to assist in controlling spread of the main fire or to remove foliage rom unburned "islands" along the fire-control line. A continuous nd intense blast of flame is needed to do a satisfactory job, and while he back-pack type outfit is a great aid, it lacks the volume and con-entration which can be developed with a power outfit.

The mobile flame thrower was designed to provide a larger and more powerful unit for use in difficult backfiring jobs along roads and rails. It consists of a light angle frame mounted on standard swivel-ype trailer wheels. The wheels are sprung and so attached to the rame that they are free to turn, lock pins being provided to hold the



General detail of flame thrower.

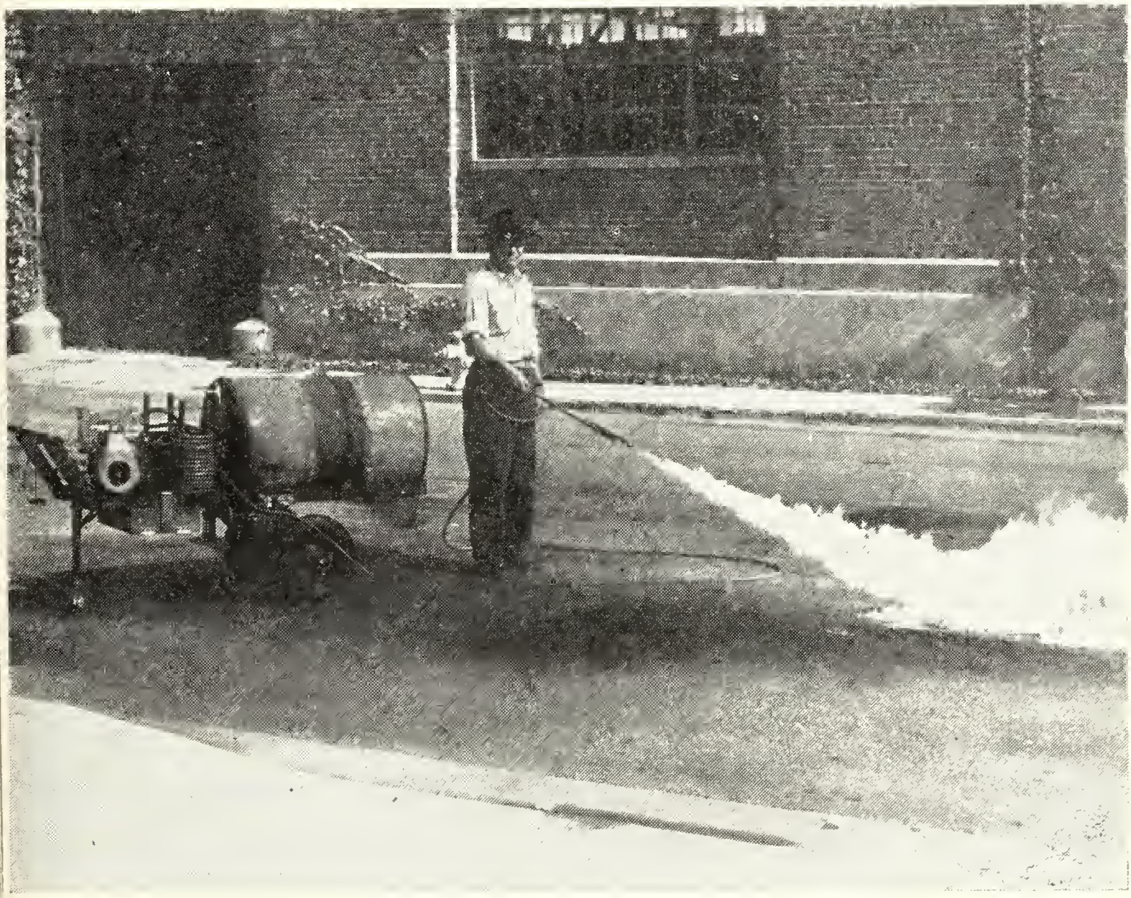


Flame thrower ready to trail.

vheels in alignment when the outfit is being moved by hand. A small .djustable castor wheel carries the weight in front. A drop-type tow-ar attachment is provided to slip over the tail gate of a pick-up ruck, providing a means of making a rigid tie between tow bar and ruck.

The frame is designed to hold a standard barrel, which is fastened o it with a loop chain and wing nut. The forward end of the frame olds a small tool box, a pony-type 1 h. p. air-cooled gasoline engine f the 4-cycle type, and a small gear pump. Standard plugs with ittings are provided for attaching the hose to the barrel opening. regulation by-pass is provided so that fuel will return when the ozzle-control valve is closed. The barrel is loaded on the rig by tanding the unit on end and picking up the barrel in the same manner s would be done with a hand truck. One hundred feet of gasoline ose is provided to permit use at some distance from the road. The lame thrower head is a standard device to which has been fitted a neumatic-type plunger control valve.

When attached to the pick-up the wheels are free and the outfit ecomes, in effect, an extension of the pick-up body, since the connec-ion between tail gate and tow bar is rigid. It can be backed or therwise moved, and tracks quite well except on rough and uneven oads. The narrow tread has not proved a handicap on rough ground. he outfit was designed with the idea that it might be desirable to aul it by hand over fire lines. For this purpose a drag rope is rovided and lock pins for the wheels hold the swivels in line. The otal weight of the unit loaded is approximately 500 pounds.



Flame thrower in action.

One barrel of fuel oil will give a continuous blast of flame for 55 minutes with the standard flame-thrower head; however, it probably will never be so used. There will always be periods when it will be desirable to shut off the flame. The flame thrower operates cold—no pre-heating is necessary—and there is no heat generated in the device during operation. The bypass, which is set at 100 pounds pressure, permits shut off of the control valve at will, without injury to pump or engine.

While the unit was originally intended as a flame thrower outfit, it appears to have a field as a water-using rig. It can be used alternately for flame-thrower work or as a water outfit by merely substituting a barrel of water for the barrel of fuel oil and using a standard back-pack nozzle tip.

The outfit has been assigned to Los Padres for a thorough field test both as a water rig and flame thrower. Blueprints are now being prepared and will be available to interested agencies through the regional forester at San Francisco, Calif.

"SPINNING FIREMEN" METHOD FOR GRASS FIRES

AXEL LINDH

Fire Control, Region 1, U. S. Forest Service

At the Ogden meeting, methods of increasing the output of held line per man-hour on grass fires came under discussion. The presentation of prodigious line work in Region 8 by use of belting flaps aroused the competitive spirit of Region 1 representatives who, though confident of equally good records, had no statistics at hand. The following article not only shows remarkable production but presents a new and interesting method of suppression:

A major part of the grass-type area in which Region 1 must fight res is located outside of national-forest boundaries in the associaion areas where fire protection is under a cooperative agreement. he table herewith was prepared from the 929 records of the fires ught in the principal grass areas of Region 1 during 1939. Cheat rass average production of held line worked per man-hour on the olo Forest is 32.3 chains. In the bunch grass on the Helena and eerlodge, production figures show an average of 9.5 chains per manour.

CHEAT GRASS

Name of fire	Number men working	Fire edge worked (chains)	Production chains per man-hour
olo:			
Reid	21	539	10. 3
Waterworks	4	120	37
De Smet	2	30	30
Mount Sentinel	5	32	40
Airport	2	20	20
Ball park	6	7	14
Airplane	1	18	72
Reservoir	4	30	20
Fairgrounds	4	12	48
Average	5. 4	90	32. 3

BUNCH GRASS

elena:			
Mount Lenox	5	83	23. 7
Cabin Gulch	20	40	1. 6
Hauser Lake	1	6	4. 3
White Horse	18	150	7. 5
Average	11	69. 7	9. 2

BUNCH GRASS—Continued

Name of fire	Number men working	Fire edge worked (chains)	Productio chains pe man-hou
Deerlodge:			
Thampom Park	7	5	5
School House	4	25	2.
Haggart Ranch	2	3	4.
Fitz Creek	2	35	30
Red Hill	29	275	5.
Average	8. 8	68. 6	9.

The method used in suppressing these fires was developed by Ranger Al Austi of the Lolo National Forest. The Fox-Newsreel men called the organizatio method the "spinning firemen." Others have called it the "Austin rotary crew' method.

Instructions to the firemen handling these fires are to take a shovel only, start at the back or lower end of the fire from a dead point in the line and dirt out the edge of the fire, looking back every three or fou shovelfulls to be sure that no fire is being left on the edge behind. When two or more men attack a grass fire they start from a common point and proceed in opposite directions along the edge.

If one man alone begins, he must start his line from a road, trail, railroad track, ditch, or break in the grass which will not be outflanked, or depend upon immediate follow-up. Here, if we can't send two men together, the follow-up is immediate, and the first man's instructions are to start at the back at the point of slowest spread and attack immediately. From 6 to 12 feet of line are made with each shovelfull of dirt, properly placed. Efficiency in placing dirt to best advantage is gained after about two fires with coaching. Here this experience is usually gained in burning firebreaks at the beginning of the grass-fire season each year. There is a crucial point in the edge of the blaze which may be found only through practice and experience, and placement of dirt anywhere else is wasted effort.

Four or five men are about the maximum that can perform efficiently on one part of the line at a time; with more than three, one is assigned to carrying water and to watching the rear so the others can devote their entire attention ahead. Where two or more men are working together it is important that they not get in each other's way at any time, and this is avoided by having the last man throwing dirt, step out several feet from the line. Thus he gets away from the heat of the fire and has the greatest possible choice of places to get a fresh shovelfull of dirt. The next man passes along the line behind him, throws his dirt straight along the out edge of the blaze, quickly spats out with the back of his shovel any small missed parts of the blaze and steps out of the way for the next man, so rotating clockwise for right side of the fire line and anticlockwise for the left.

AN EYE TEST FOR LOOKOUT MEN

George M. Byram

Appalachian Forest Experiment Station

The importance of keen eyesight to efficient detection has always been recognized, but none of the standard optical test methods have been suited to the conditions under which forest-fire lookout men operate. The device and test method here described were presented at the recent Ogden meeting and their general acceptance is indicated by requisitions for a supply of the cards by each region.

The efficiency of a forest-fire lookout man depends mainly on four ualifications: (1) experience, (2) knowledge of his territory, (3) alertess, and (4) quality of his eyesight. A man's rating on the first hree factors can be judged with reasonable accuracy, but some sort f measurement is necessary to determine his rating on the fourth.

The importance of eyesight can be shown by considering possible dvantages to be obtained by manning a lookout network with indiiduals having keen eyesight. These advantages are: (1) an increase n the visual range of small smokes, which might be regarded as equivlent to a haze-cutting filter (no such device is known at present) sed by a man with ordinary eyesight and (2) shorter discovery times or smokes within the visual range. A lookout network with men of een eyesight, compared with a net work with men of normal eyeght, other qualifications being equal, might be regarded as giving ore protection for the same amount of money or, by using fewer men, he same protection for less money.

In 1932, the writer assisted in developing a preliminary eye test at he Pacific Northwest Forest Experiment Station for measuring the bility of lookout men to see small smokes.[1] This test was developed or another purpose but since then has been widely used by the Forest ervice for testing the vision of lookout men. If carefully given under niform lighting conditions, it yields good results, but since it is often ifficult to obtain the proper lighting, the test at times has proved nsatisfactory for general use.

An eyesight test for forest lookout men has been developed at the ppalachian Forest Experiment Station which meets the following ssential requirements: (1) gives ratings proportional to the distance which lookout men can see small smokes, (2) gives ratings the values which are independent of light intensities, and (3) is sufficiently mple for field use.

The test consists of measuring the distance at which an individual n see a black circular spot ⅙ of an inch in diameter on a white backound about 7 inches square. The eye-test pattern (see p. 124) is inted on glossy white photographic paper by means of a master gative, and is cemented to stiff, inflexible backing. The ⅙-inch ack dot is located on a diagonal of the eye-test board or target halfay between a ¼-inch central black circle and the end of a black strip

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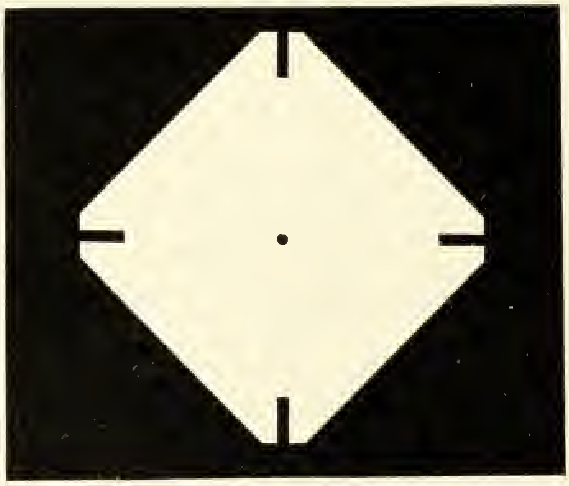
McArdle, Richard E., and Byram, George M. An eye test for fire lookouts. Jour. Forestry 34: 794-, August 1936.

at the corner of the diagonal. The last two figures on the pattern serve only as markers which enable the observer to know where to look for the small black circle.

The test can be given most satisfactorily on a day when the sky is overcast, but equally good results can be obtained on a sunny day if the target is shaded from the direct rays of the sun. In any event, the target should not be in deep shade such as occurs directly under the canopy of a tree, but should be exposed to the full light of the open sky.

In taking the test, the observer walks away from the eye-test board until the $\frac{1}{16}$-inch black spot becomes rather faint, and this usually happens at about 35 or 40 feet. The eye-test board is then whirled so that the small black spot is in a new position, which may be up, down, right, or left. The observer then indicates the position of the spot, and if correct, he steps back a few feet and the procedure is repeated until he indicates a false position of the spot. His rating is then recorded as the distance in feet to the last point at which he indicated correctly the position of the black spot.



Lookout eye-test pattern.

The small black spot becomes more indistinct as the observer moves farther away, but he should continue to guess its position even though he lacks confidence in his ability to do so correctly. Some individuals wish to rest their eyes between observations, although prolonged looking does not seem to change a man's rating.

The chart on page 125 shows the effect of light intensity on the visual range of three different types of eye-test targets. Light intensity is expressed as brightness of the white component of the target in candles per square foot. Curve A is plotted from observations made with the new eye-test board under various light intensities. Only a very low brightness levels are the ratings seriously affected. For this reason the test should always be given out of doors, where even on rather dark, cloudy days the light intensity is high enough (about 75 candles per square foot for a white surface) to give reliable ratings. On the other hand, the target should not be in direct sunlight (about 1,000 candles per square foot for a white surface) or ratings will be slightly lowered. Curve B shows the relation between light intensity and the visual range of a $\frac{1}{16}$-inch white spot on a black background. The visual range of the white spot is considerably affected by light intensity. Curve C is a similar curve for a white spot on a grey black-ground. This type of target would also be suitable for a lookout eye test but it is difficult to construct so that the white and grey components will always have the same brightness ratio.

The visual range chart also shows that the target combination of black on white satisfies the second requirement for a lookout eye test. That this combination also satisfies the first requirement was determined in three different ways:

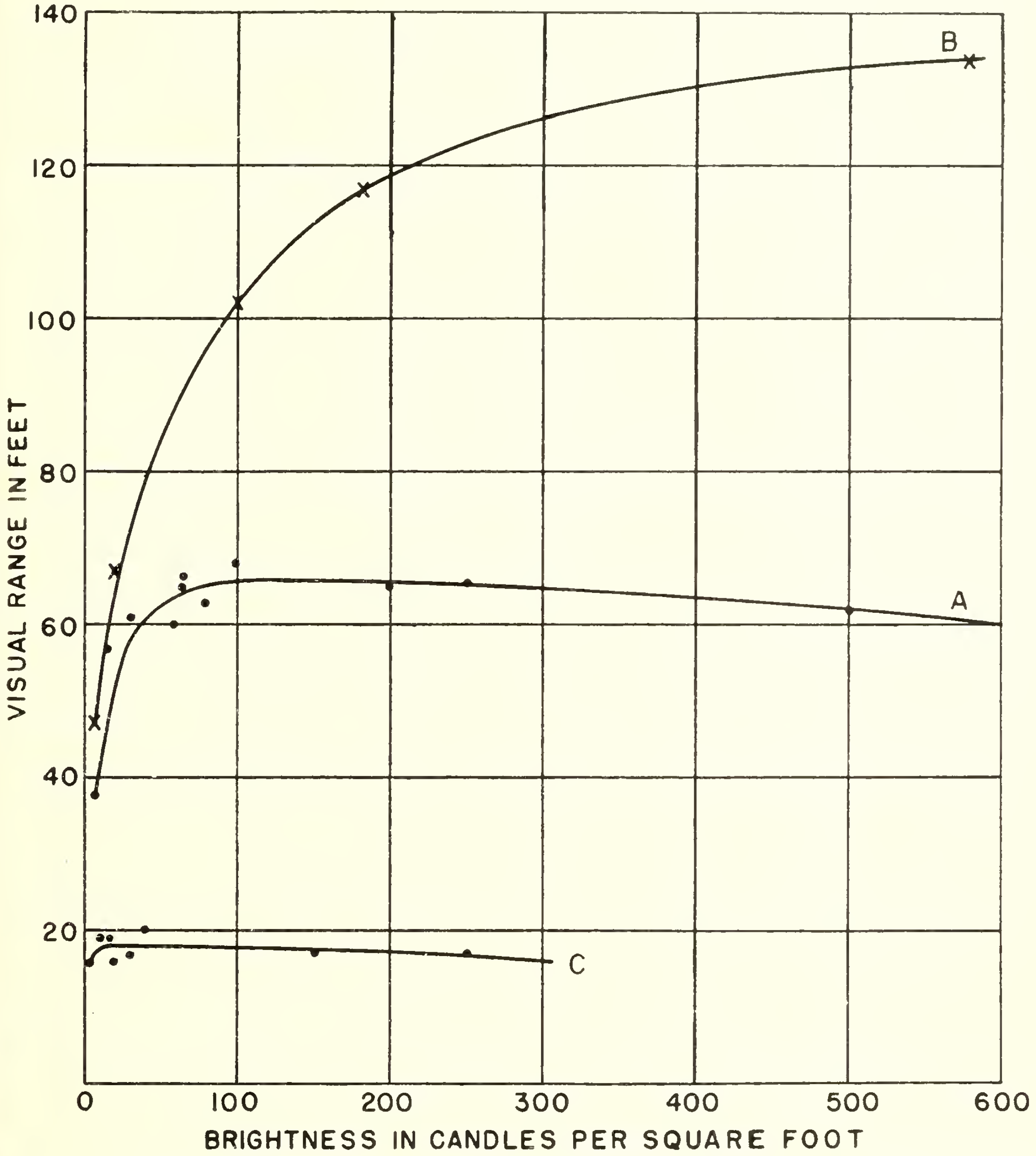


Chart 1.—The visual range of three different target-background combinations plotted against the brightness of their white components. Curve A, black on white; curve B, white on black; curve C, white on grey.

(1) Tests were made on actual smokes with men of known but different eye test ratings. This was the most direct but least satisfactory method of determining whether the eye test met the first requirement. The results of five tests on seven men showed that men who rated poor on the test could not see smokes as far as men who rated average, and men who rated average could not see smokes as far as men who rated good or exceptional. To obtain actual quantitative relations between eyesight and smoke-seeing ability by this

method would require hundreds of tests and the results probably would not be as reliable as the more indirect laboratory methods.

(2) An observer with normal eyesight simultaneously viewed a smokelike target and the lookout eye-test target with his vision normal and then with his vision impaired in some way, such as by using glasses with strong convex lenses, or by viewing the targets through small diaphragms. In this way it was possible to duplicate various visual defects and yet have all observations made by one man.

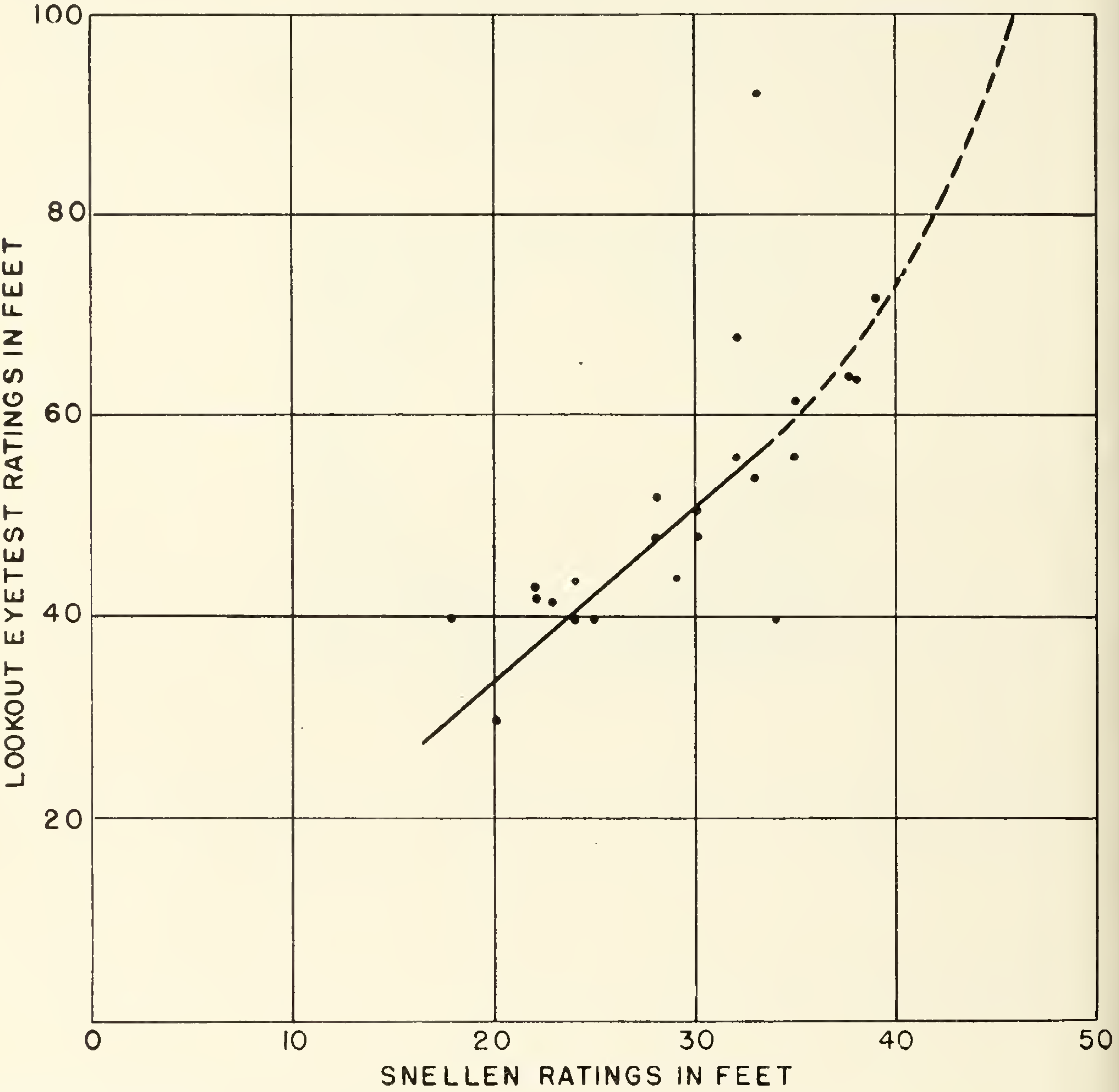


Chart 2.—Ratings obtained with the lookout eye-test plotted against ratings obtained with 0.3-inch letters on the Snellen chart.

The results showed that the visual range of both types of target was reduced in almost the same ratio by any given visual defect.

(3) Mathematical calculations of the true form of retinal images showed that the form of the image of a small smoke on a distant landscape is the same as the image of a small target (either black or grey on white or white on grey).

The chart on this page shows the relation between ratings of different men, obtained with the new lookout eye test and with the usual letter-type charts used by oculists. Ratings were plotted against the maximum distance that each man could read 0.30-inch letters on the Snellen chart. This curve indicates that the letter-type chart could be used for determining poor or even average eyesight, but would not show which men have exceptionally good eyesight ("eagle eyes"). The reason for this is that the visual range of small letters which can just be read is affected by any factor which obscures detail, and for men with poor eyesight the most important factors are structural defects in the eye and lack of retinal sensitivity. The visual range of the eye-test target is affected by these factors in a corresponding manner, so a linear relation is obtained for the lower part of the curve when the visual range of small letters is plotted against the visual range of the eye-test target. However, individuals with exceptional eyesight probably have highly sensitive retinas and few defects in the structure of their eyes. The visual range of small letters for these men will be limited chiefly by the wave length of light, and there is a definite limit to the distance the letters can be read, no matter how good the observer's eyesight. There is no definite physical limit to the visual range of the black spot on the eye-test target or the visual range of a small smoke. Retinal images of these objects are affected differently by diffraction that are the retinal images of letters.

The data plotted in chart 2, page 126, are not sufficient to determine whether that portion of the line shown as dotted should curve upward. That this must be true can be found from calculating the angular limit at which the details of the letters can be recognized. For the 0.30-inch letters used in this test, this limit comes at about 60 or 65 feet. No matter how keen a man's eyesight, he will not be able to recognize the letters at distances greater than this, hence the curve should turn upward and approach the 60- or 65-foot limit as an asymptote.

The letter type of test should give fairly accurate results for about 70 percent of the men tested. It probably would not be accurate for the upper 30 percent, and since there is a definite limit to the distance at which a letter of a given size can be recognized, the letter test would be inaccurate for the upper 5 percent or "eagle eyed" individuals. The letter type of test has other drawbacks:

1. Men familiar with letters can recognize them at slightly greater distances than men who are not familiar with them. The visual range is affected by the "degree of literacy."
2. Different letters of the same size are not equally visible.
3. The letters on any one chart can be memorized.

Table 1 shows the visual range of a small standard smoke for various eye-test ratings and haze-meter readings. It can be seen that large variations in eyesight cause much smaller variations in the visual range of smokes. This might indicate that a man who rated high on experience, alertness, and knowledge of his territory would perhaps make a good lookout even though his eyesight were no better than average. A new man, or a man who rated only average on the qualifications just listed, should perhaps have better than average eyesight. With the figures of table 1 available to him, the judgment of an experienced fireman on this point might be more effective than any set rule as to how good a prospective lookout man's rating should be to qualify for detection work.

Table 1 appears to contradict the statement that the distances at which lookout men can see small smokes are proportional to eye-test ratings. However, this is not so, because the figures in table 1 have been corrected for the difference in atmospheric haze between the distances corresponding to the high ratings and the distances corresponding to the low ratings. If one man has an eye-test rating of 60 feet and another man a rating of 50 feet, then the first could see a smoke column 6 miles when the second could see it only 5 miles, provided both men were looking through the same amount of haze. However, in actual practice the man who has a high rating will have to look through more haze and this will reduce his superior range of vision, which tends to bear out the statement that of all factors affecting the visibility of small smoke columns, haze is the most important.

TABLE 1.—*Visibility distance of small smoke (miles)*

Eye-test rating	Hazemeter readings							
	2	4	6	8	10	12	14	16
72	3.4	5.5	7.3	8.9	10.5	11.9	13.2	14.5
64	3.3	5.3	7.0	8.6	10.1	11.4	12.7	13.8
56	3.1	5.1	6.8	8.3	9.7	10.9	12.1	13.2
48	3.0	4.9	6.5	7.9	9.2	10.4	11.4	12.4
40	2.8	4.6	6.1	7.5	8.7	9.7	10.7	11.6
32	2.6	4.3	5.7	6.9	8.0	8.9	9.8	10.7

Table 2 gives the average ratings (separated into groups) of 54 men. It is possible that as additional tests are made the weighted average will be changed slightly. As a class, the relief workers rated considerably lower than other classes, and it was assumed that diet was largely responsible for this low rating.[2]

Standards or classes of performance are shown in table 3 for various distance ratings in feet. The approximate relative smoke-seeing ability corresponding to each class is also given. For purposes of comparison, atmospheric conditions are assumed to be such that a man with average eyesight could see a small smoke 10 miles away.

TABLE 2.—*Average eye-test ratings for four different groups of men*

Class	Number of men	Average rating in feet
CCC enrollees	15	55.5
Regular Forest Service personnel	19	57.0
College students	11	54.3
WPA relief workers	9	43.4
Weighted average		53.8

TABLE 3.—*Tentative standards of performance and relative smoke-seeing ability for different class intervals of eye-test distance ratings*

Eye-test rating in feet	Performance rating	Relative smoke visibility rating in miles
64 or more	Exceptional	11.0 or more.
58–64	Good	10.5.
50–58	Average	10.0.
44–50	Fair	9.5.
44 or less	Poor	9.0 or less.

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[2] Byram, George M., Vision and diet, Service Bulletin, February 5, 1940.

A SLIP-ON TANKER UNIT

F. W. Funke

Specialist in Fire Control Equipment, Region 5, U. S. Forest Service

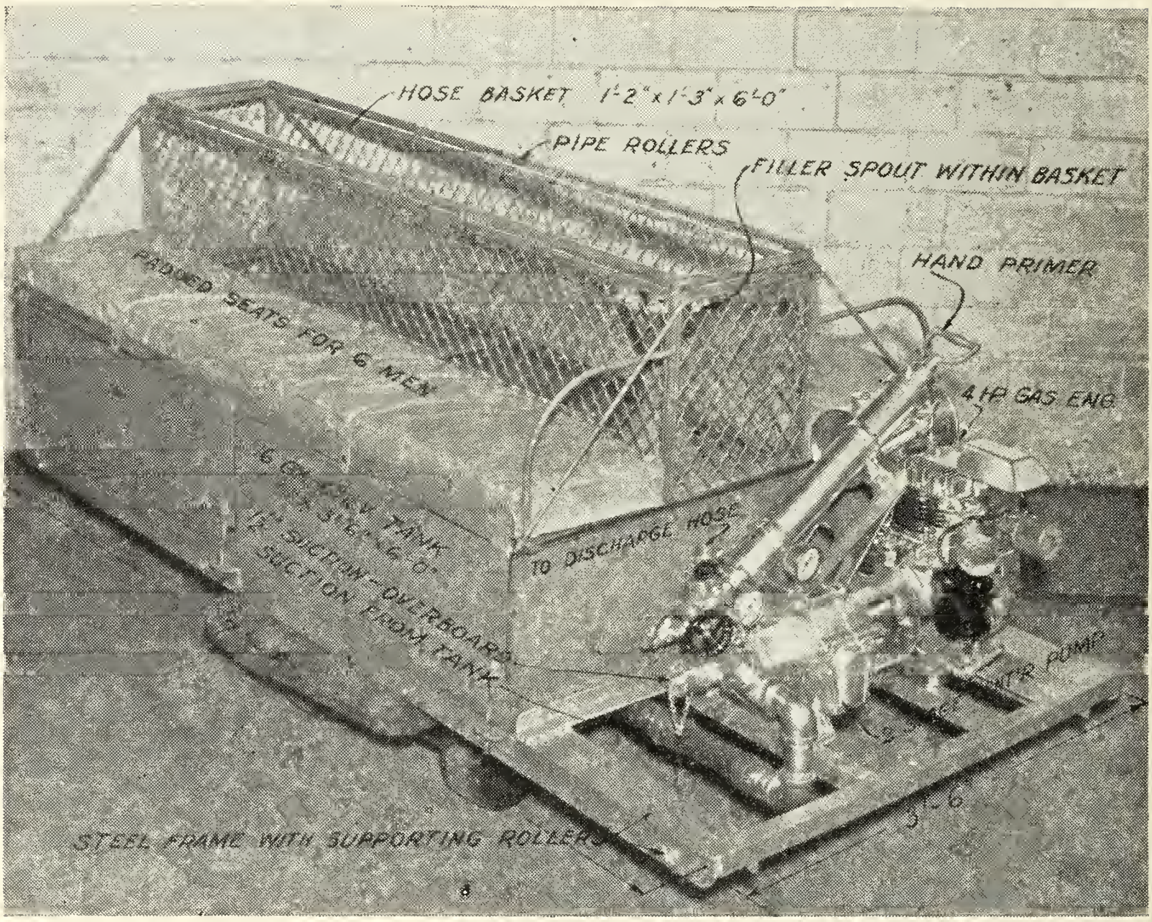
Experience in 1939 strongly emphasized the need for some cheap and flexible way of converting ordinary stake-body or pick-up trucks into efficient tanker units. At times of extreme fire danger there is an urgent need for more tankers than can possibly be provided when a tank, a pump, and a truck are all built into one permanent unit in the conventional way. Such build-on units tie up a truck permanently for tanker purposes and so increase the investment per tanker unit that the total number available would always be less than if tanks and pumps were readily detachable from the truck when the truck is needed for other purposes—or when the truck chassis is worn out. The Region 5 slip-on tanker unit[4] is therefore a direct answer to a fire-fighter's prayer. While the slip-on tanker equipped with a hand-power pump, now used on the Texas National Forests, supplies the same flexibility at a cost of perhaps $120 less for the pump, this Texas outfit requires at least two men to operate the pump. Sometimes this need for two pump men would be a serious drawback.

We have long toyed with the idea of a compact slip-on type of pumper unit which could be quickly mounted and carried by a standard stake-side truck. Region 5 forests have urged such a development for some time. However, it is only recently that a suitable pump and engine have been made available.

There is a definite appeal to development of this kind. Cost is, of course, an important factor in determining the type of equipment which will buy the most effectiveness for the money invested. From an investment standpoint the present unit probably offers more in the way of utility than any thus far suggested by the field. It is generally accepted that a small quantity of water in the hands of an experienced suppression man is equal in effectiveness to the efforts of three men with hand tools. We do not yet know how much more effective the combination of a trained crew and a power pumper is over a similar crew without water. However, there are many instances on record where fires could not have been held without the liberal application of water from pumpers. Probably of greatest importance is that low cost units can be made more generally available to the field and the effectiveness of initial attack crews increased to a point far beyond that possible by a similar expenditure for manpower.

The Slip-On Unit

The unit (see p. 130) consists of a light 4-inch channel frame, to which is attached a 16-gage galvanized iron water tank built to specifications contained in the Fire Control Equipment Handbook. Present capacity is 196 gallons, this capacity being determined by



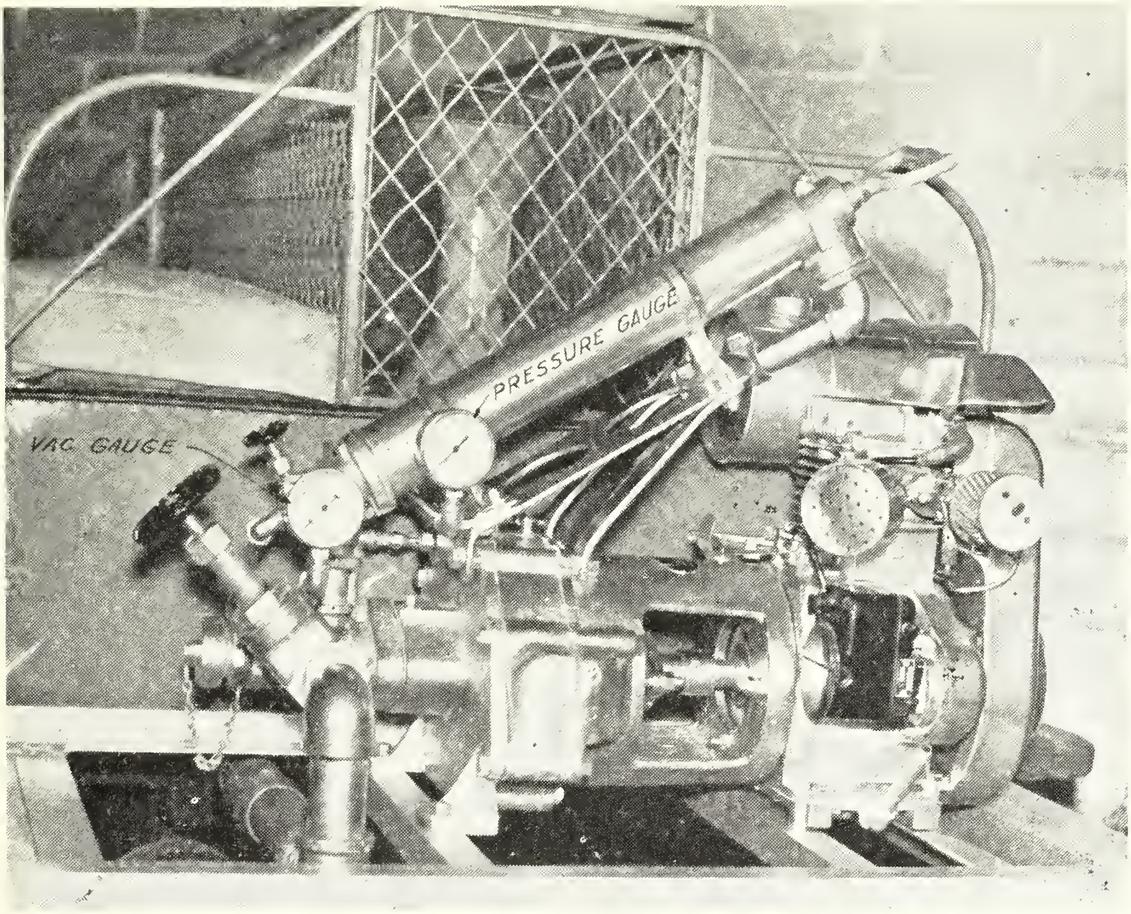
the sheet metal sizes used in framing the tank. A hose basket mounted on the top of the tank also serves as a back rest for the crew. Latex-treated hair cushions provide a comfortable seat. Connection between pump and tank is through a short section of suction hose. The complete unit as shown, empty, weighs less than 500 pounds; loaded with water and hose weighs approximately 2,600 pounds. As provided the field in Region 5, the unit is equipped with 200 feet of ¾-inch high-pressure hose, a shut-off nozzle with three tips and four lengths of 1½-inch suction hose with foot valve and strainer. Total cost of the unit is approximately $500 in lots of 10.

Four rollers to the side are provided, as shown on the channel frame, so that the loaded unit can be rolled from a skid frame to a stake-side truck and bolted in position by one man. Suitable bolsters and U-bolts, not shown, are provided to hold the outfit in place on a truck bed.

Power Plant and Pump

The power unit, which weighs 160 pounds, is a 4 h. p. air-cooled, 4-cycle Wisconsin engine driving a 2-stage centrifugal pump through a built-on cage, the entire assembly being manufactured by a local pump company. Present cost of the pump and engine assembly is $154 each. A standard marine type bilge pump is attached for priming purposes and suitable vacuum and pressure gages are installed. Attachments and piping have been reduced to a minimum (see p. 131).

The performance of the unit is somewhat lower than standard portable power pumps, and it is not intended in any sense to displace



the regular portable pumper with units of this type. The performance range is 140 pounds per square inch at 22 g. p. m., and at the other end 80 g. p. m. at no head. However, the pump characteristic is such that from the no-head side pressure is quickly built up and approximately 60 g. p. m. is available at 100 pounds pressure.

In some applications the unit might be cut down in size to 80 gallons and used on a pick-up truck where such a vehicle is provided the initial attacking force.

Interested agencies may secure additional technical data by addressing the Regional Forester, United States Forest Service, San Francisco, Calif., Office of Fire Control.

Gelatin for Greater Work Output.—The part played by protein in the diet has been brought to the fore this year by the report of Ray and his associates that gelatin increases the capacity for work. Six men, after a period of training on the bicycle ergometer, washed down with orange juice 60 grams of dry gelatin daily for 6 weeks. Their capacity for work rose steadily for a month or more, finally attaining an output 50 percent or more higher than at the beginning. When gelatin was discontinued, their work capacity diminished nearly to the control level. A large fraction of the work was done anerobically, that is, by accumulating an oxygen debt, and the authors suggest that gelatin increases the store of phosphocreatine and so the capacity for accumulating a debt. If these conclusions prove to be sound, gelatin pills may take their place beside salt and glucose tablets in modern mills and factories.—THE MANAGEMENT REVIEW.

DEVICES FOR COMPUTING SUPPRESSION COVERAGE

MARION N. NANCE[1]

Junior Forester, Region 6, U. S. Forest Service

Guard-placement planning, in order to be sound, should be based on data which are fundamentally accurate to an acceptable degree.

In an attempt to assist field men in the construction of suppression coverage maps of a more nearly consistent degree of accuracy and to reduce the time necessary for this work, the two devices illustrated (see pp. 133 and 134) and explained here were developed.

CHART 1

A. Use of the device.

1. Determine the rate of travel in miles per hour for the trail in question. Consider an average fire guard, the weight of his pack, condition of the trail, gradient, etc.

2. Set the straightedge of the transparent arm D on the rate of travel along the A axis (miles per hour). The arm is set on 3 miles per hour on chart 1.

3. Determine the number of minutes available for travel along the trail.

4. Follow vertically from the horizontal axis B the minutes-traveled line until it intersects arm D. For example, the 40-minute line intersects arm D at X on chart 1, page 133.

5. By following to the left the horizontal line which forms the intersection at X, the number of ¼-inch divider units to be stepped off along the trail may be read directly from the chart along the C axis; i. e., four divider units in the example stated. No computation is necessary to convert distance to divider units.

B. Adverse grades (vertical curvature) are given consideration in the rate of travel used.

C. Poor alinement and angles and bends in the trail (horizontal curvature) are considered in the size of divider unit used along the C axis and in setting the dividers before stepping off the distance along a trail.

D. Variations in chart arrangement.

1. The chart can be made for 60 or 120 minutes.

2. If 120-minute chart is used, an A axis (miles per hour) can be added at the 60-minute line.

3. The C axis (number of divider units) can be graduated in any convenient unit. Chart 1 is for a ½-inch-scale map. The units on this chart would be ⅛ inch for a ¼-inch-scale map, ½ inch for a 1-inch-scale map, etc.

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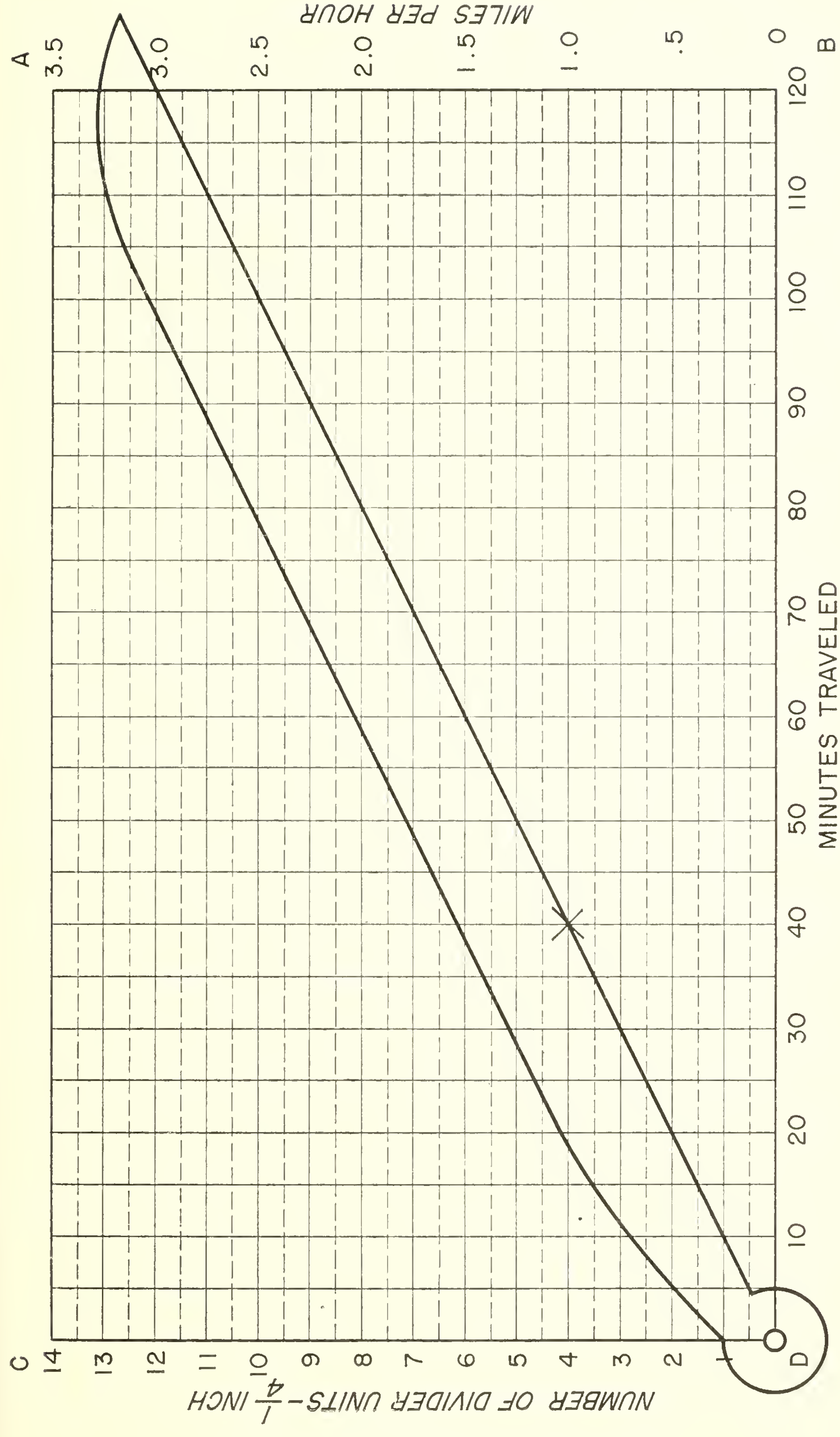
[1] The author expresses his appreciation for the advice and friendly criticism of this article by John C. Wilkinson and Robert E. Reinhardt. Special recognition is given Robert E. Reinhardt for his original ideas in the development of the travel coverage computer.



(For $\frac{1}{2}$" scale map)

CHART NO. I

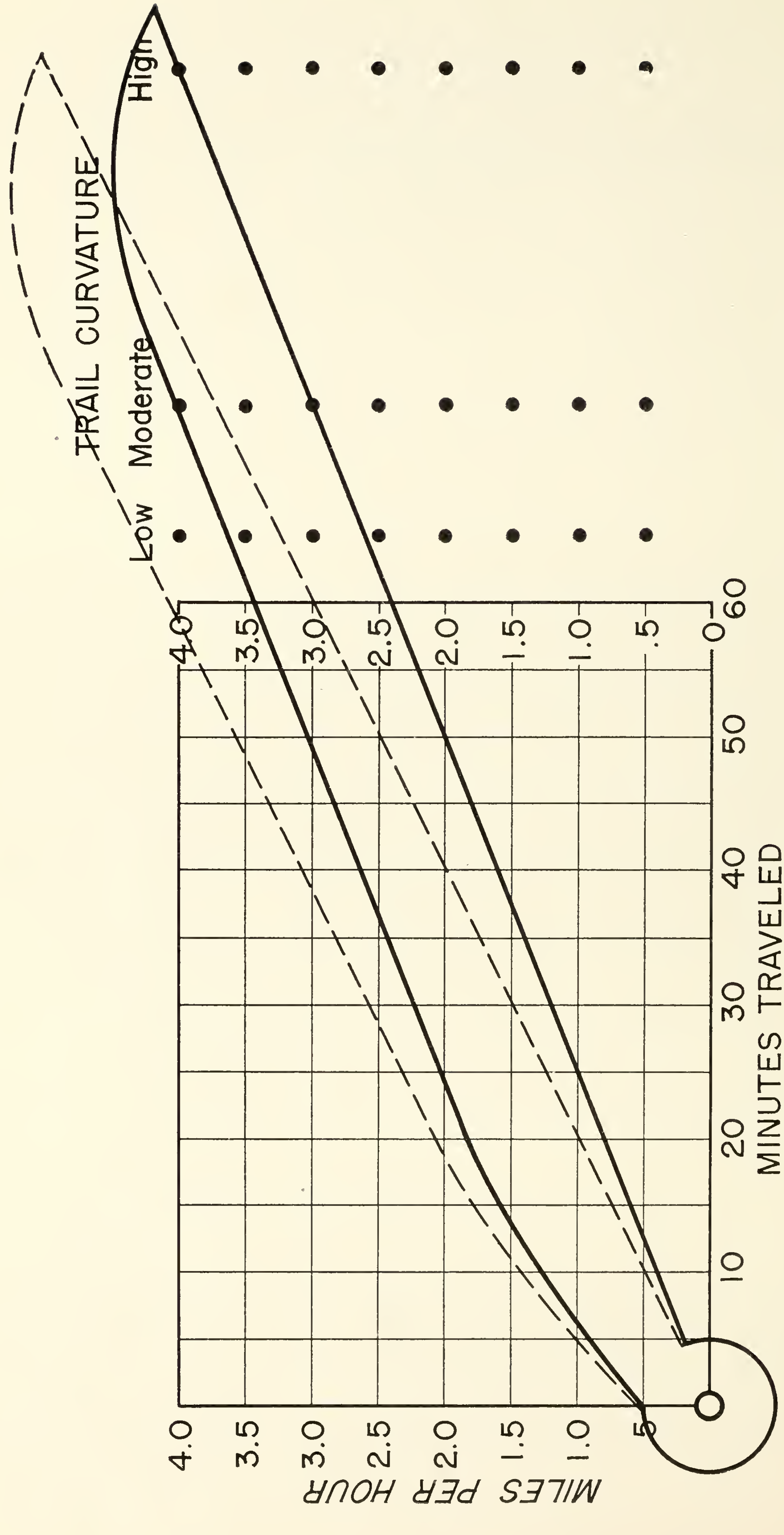


CHART NO. 2

(For $\frac{1''}{2}$ scale map)

4. Horizontal and vertical scales can be lengthened or shortened to suit individual preference by changing the graduations along these axes.

5. For travel along roads a similar chart can be made.

6. For comparable accuracy rough topography requires the use of a small divider unit.

Chart 2

This chart illustrates a very practical variation of chart 1. The device, called a Travel Coverage Computer, is made of plastacele and is 3 x 6 inches in size. Compensation for trail curvature is provided by the addition of three rows of dots which are prolongations of each horizontal "miles per hour" line. As shown on chart 2 the rows of dots are used to allow consistent adjustments for low, moderate, or high trail curvature.

A. Directions for use of the Travel Coverage Computer:

1. The procedure for determining the miles per hour that the average fire guard can travel is the same as stated for chart 1. On chart 2 the selected rate of travel is shown as 3 miles per hour by the dashed lines of the transparent arm.

2. To compensate for differences between actual field conditions and those indicated on the map a further adjustment of the device is necessary for trail curvature. It is assumed that the person using the computer is familiar with the trail in question and can therefore decide whether the trail has a low, moderate, or high amount of curvature. On chart 2 the transparent arm has been moved from its first setting of 3 miles per hour to the dot under "moderate" trail curvature, indicating that we are considering a 3-mile-per-hour trail with moderate curvature.

3. The distance traveled in any number of minutes up to 60 is automatically shown directly below the transparent arm as the length of the vertical line corresponding to the number of minutes traveled. Thus on chart 2 the distance traveled in 50 minutes is 2 miles.

4. Since dividers are not always available, small holes are bored at the intersection of each horizontal and vertical line; i. e., at 5-minute and ½-mile intervals. To use the device place the point of a sharp pencil in the bottom hole of the column representing the number of minutes available for travel. Using this and the remaining number of holes between it and the lower edge of the transparent arm as pivots (to follow bends in the trail) "walk" the distance off directly on the map.

B. Cross-country travel can be calculated in the same manner as for trails. Travel along roads can be computed by multiplying the miles-per-hour figures on the computer by 10 (2.5 m. p. h. equals 25 m. p. h.) and scaling 10 times the distance along the road.

C. An eyelet or a small bolt can be used to attach the arm to the plastacele.

EFFECT OF SIZE OF CREW ON FIRE-FIGHTING EFFICIENCY

Donald N. Matthews

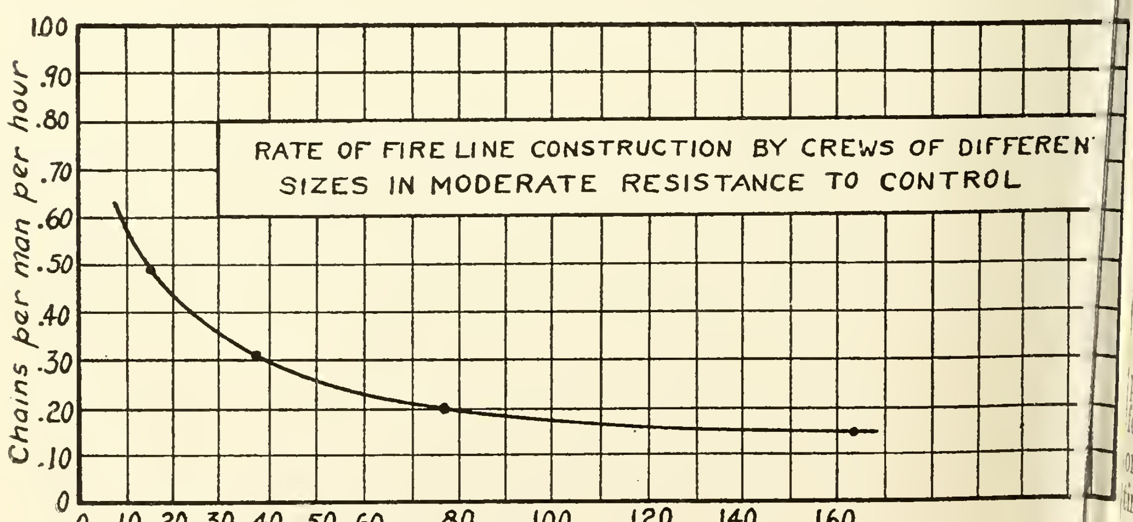
Pacific Northwest Forest and Range Experiment Station

Hand-work methods of fire control are still required in the hea fuel types and the rugged topography of the Douglas fir region spite of the advances that have been made in the use of machine Thus, on many fires topography, accessibility, and to some exte fuel types make machinery impractical and make it necessary fight fires with crews of men equipped with hand tools. Immer amounts of work are required per mile of fire perimeter. Theref the per-man efficiency of the men in the crews is a vital concern a has been the subject of the study reported upon here.

Because of its importance and the large amount of time it consum the control-line construction job was singled out for study. Spe cally, this includes such operations as clearing the line of brush, sn trees, snags, vines, windfalls, rotten wood, and roots, and diggin trench to mineral soil. It does not include such subsequent operat as burning out the strip between the control line and the fire, b firing, snag falling inside the line, patrol, or mop-up. In practi was not practical to draw this distinction very fine because some is spent on these other jobs while line construction is in prog

The accompanying chart indicates the per-man output of pleted control line obtained from data gathered on 40 crews since 1 As used here, a crew is the total aggregation of men working from end to the other of a unit of control line regardless of the numb the internal subdivisions into straw-boss or foreman groups.

The chart reveals the most important fact uncovered by the st The chains of control line produced per man per hour decreases a



size of the crew increases. Thus the data gathered indicated that 8 crews of from 10 to 20 men (average 15 men) produced an average of 0.49 chain (1 chain=66 feet); 19 crews of 21 to 55 men (average 38 men) produced an average of 0.31 chain; 7 crews of from 56 to 105 men (average 76 men) produced an average of 0.20 chain; and 6 crews of from 106 to 212 men (average 163 men) produced an average of 0.15 chain per man per hour.

Admittedly, these results are not very precise because of the difficulties encountered in getting comparable measurements in a study of this kind. The production figures were obtained from many different kinds of crews—CCC's, loggers, and pick-ups—working under a wide range of conditions on the national forests and private lands of the region. Some of the data were collected by the administrative personnel of the national forests, but most of them were obtained by the research personnel of the experiment station. Most of the crews were organized according to patterns in vogue before the one-lick method was developed. Each unit of line varied in length from 10 chains for the shortest to 196 chains for the longest with an average length of 69 chains. In almost all cases each unit of line was worked in one shift or working period and most of these working periods were from 3 to 10 hours in length. The data reveal only a very slight effect of length of working period; i. e., there is only a slight tendency for the lowest rates per man per hour to be associated with the longest shifts. Possibly this is due to the fact that most of the working periods were short.

Early in the study it was found that the best way to get worth-while records was for one trained man to devote all of his time to observing a crew. The usual procedure was for this man to follow along behind the crew and rate each chain of completed line as being either *low*, *moderate*, *high*, or *extreme* resistance to line construction, according to the standard fuel-type classification used in the region, and to make note of the number of men and the hours worked. The foremen, straw bosses, water boys, etc., with the crew were included in counting the workers; truck drivers, packers, cooks, etc., not on the control line were not included as workers. Travel time to and from the control line and rest periods of more than 30 minutes were not included in the working time. Since by definition the four resistance-to-line-construction classes have approximately the numerical relationship 1–2–4–8, it was possible to compute an average resistance-to-line-construction rating for each unit of line studied as well as the rate per man per hour and to recompute these to obtain an approximate rate per man per hour under a uniform *moderate* resistance-to-line-construction condition. Thus the rates obtained from the measurements made on the individual crews were all made roughly comparable by determining what the rate would be under *moderate* resistance to line construction before they were included in the figure for purposes of comparison.

Analysis of the records of 1,564 fires controlled in the first work period by crews of from 1 to 30 men also revealed a strong tendency for output per man per hour to decrease as the number of men working on a fire increased, although the fire records do not sharply separate time spent on control-line production from other control work. This analysis indicated that the longer the period worked the lower the rate of output per man per hour. More recently time and production records obtained in the field by the record keeper of the Forest Service's experimental 40-man crew assigned to Region 6 (Washington and Oregon) on 19 units of fire perimeter on which they worked were analyzed, and these indicate that after making the resistance to line construction roughly comparable (*moderate*) for all cases, in the 11 cases where the crews working on line construction contained less than 18 men (10 to 17 men) they produced 1.31 chains per man per hour, but that in the 8 cases where the crews contained 18 or more men (18 to 29 men) they produced 0.93 chain per man per hour. These records, which were based upon the performance of one crew and measured under one standard procedure, are probably as comparable as any that have been collected in this region. They show a strong tendency for the output per man per hour to decrease as the number of men in a crew increases, although they cover a comparatively narrow range in size of crew.

If, as all these studies seem to indicate, there is a strong tendency for output per man per hour to decrease as the size of the crew increases, this tendency reveals an important principal to use in planning fire suppression. The four elements of the fire-control equation are: (1) time, (2) work to be done, (3) manpower, (4) cost. Time must be short to make the work successful. Work to be done is fixed at any one time and place. Manpower can be increased or decreased. How does the effect of size of crew affect time and costs? Suppose there is 1 mile of line to build through cover with a resistance-to-line-construction rating of *moderate*. Based on the output per man per hour shown in the chart, 15 men working as a crew and producing 0.49 chain per man per hour can produce 1 mile of such line in 10.9 hours, and 75 men working as a crew and producing 0.20 chain per man per hour will do the same job in 5.3 hours. In this example it takes 5 times as many men and costs at least 5 times as much to cut the time in half. Knowing this fact, the men in charge of the fire can decide whether the gain in time is worth the cost or decide when the point of diminishing returns is reached as to the size of a single crew. In figuring the cost of using more men to save time full weight should be given to the cost of the supervision, transportation, camp, time keeping, tools, etc. required for the larger crews. This is but one of innumerable problems of this kind that might be cited, and is but one application of the principle that output per man per hour decreases as the size of crew increases.

It is worth while to speculate a little as to why the size of crew has such a drastic effect on output per man per hour in fire fighting. Although it is common knowledge that nonproductive time tends to increase and output per man per hour tends to decrease with an increase in the size of crew on almost any kind of manual labor, nevertheless this tendency seems to be especially strong with fire-fighting crews. What is different about the fire-fighting job that makes this true?

The one outstanding characteristic of fire fighting seems to be that the work is spread out over long distances. Thus the job is measured in terms of chains or miles of fire perimeter to be worked; and therein probably lies one special reason why size of crew affects fire-fighting efficiency over and above what might be expected as the usual effect of size of crew. Fire fighting involves a great deal of walking on the job as well as the actual work of chopping, clearing, digging, etc. to be done; and therefore it seems reasonable to assume that the more men in the crew, the more men there are to walk over the same ground to do the same amount of work. If this walking time is thought of as being nonproductive time, an increase in the number of men going over the line increases the nonproductive time without any offsetting advantages except some saving in the total time required to do the job. The amount of work to be done per mile of fire perimeter is just about the same whether it is attacked by 10 men or 50 men, but 50 men spend 5 times as much time walking as 10 men working over the same ground.

Although the large amount of walking required in fire fighting seems to be an important factor in explaining why output per man drops rapidly as the size of crew increases, nevertheless nonproductive time of any kind—waiting, resting, or loafing—works in a similar way to reduce per-man output as the size of crew increases. Large crews do not have any offsetting advantages to increase their per-man efficiency; furthermore, it is common knowledge that walking is likely to be at a slower rate and that time spent in waiting, resting, or loafing is almost certain to increase with size of crew. Therefore these nonproductive time elements tend to pyramid; they increase in amount and they are at the same time multiplied by the number of men in the crew.

If, as the size of the fire-fighting crew increases, the decrease in useful work produced by each man is due principally to two elements, (1) time spent in walking, and (2) other nonproductive time such as waiting, resting, or loafing, the following conclusions and applications are pertinent:

1. Organizing a large crew into small units (e. g., straw-boss units of 8 or 10 men) or according to special patterns such as the one-lick method may have a very worth while effect in decreasing the nonproductive time due to waiting, resting, loafing, and other inefficiencies that tend to increase as the size of the crew increases and supervision is spread out thinner and thinner, but the internal organization of the crew cannot materially reduce the effect of walking as an important element of nonproductive time in fire fighting so long as all the men in the crew work from one end of the line to the other. Thus five 10-man crews working from the beginning to the end of a mile of control line have just as much walking on the job to do as 50 men covering the same ground in one crew. However, if there were a road along the mile of line to be worked and each of the five 10-man crews could be transported to and work upon ⅕ of the mile, then a very real saving in walking time on the job could be made by breaking the 50 men up into small crews, provided this was possible and desirable, because each man would have to walk only ⅕ mile while working.

2. The effect of size of crew will be most pronounced in fuel types having *low* or *moderate* resistance to line construction and less important in *high* or *extreme* resistance to line construction. Thus there is less loss in efficiency in working a large crew where there is a great deal of work to be done per unit of line than where there is very little work to be done per unit of line. This is true because the effect

of crew size is most pronounced when the nonproductive time is large in comparison to the productive time. An example of how this might work out is shown by the following theoretical values computed as indicated in the table herewith. (The table is not based on the data obtained in the study.)

Theoretical effect of size of crew on the time required to construct 1 mile of control by resistance-to-line-construction classes

Number of workers in crew	*Low* Walk 30 minutes per mile per man, work 15 minutes per chain or 1-200 minutes per mile.	*Moderate* Walk 35 minutes per mile per man, work 30 minutes per chain or 2,400 minutes per mile.	*High* Walk 40 minutes per mile per man, work 60 minutes per chain or 4,800 minutes per mile.
	Hours	*Hours*	*Hours*
10	2.5	4.6	8.7
20	1.5	2.3	4.7
30	1.2	1.9	3.3
40	1.0	1.6	2.7
50	.9	1.4	2.3
60	.8	1.2	2.0
80	.8	1.1	1.7
100	.7	1.0	1.5

The table indicates that in a *low* resistance-to-line-construction fuel type the point of diminishing returns in saving time is probably reached with smaller crews than in the more difficult fuel types. This table of theoretical estimated values should not be taken literally; i. e., the values in the tables may not be the true values under actual field conditions. Under actual conditions other nonproductive time in addition to walking time should be included in the calculations, and the total amount of nonproductive time per man should be increased as the size of the crew increases. This simple table is given to show how the fire-fighting job can be broken down and analyzed to determine the point of diminishing returns. It indicates how local conditions and local estimates of productive and nonproductive time might be used to obtain relative values that might have important implications for local use.

3. The effect of nonproductive time due to waiting, resting, and loafing tends to increase with size of crew the same as the effect of any other nonproductive time; therefore it follows that good management and good crew organization should strive to reduce all such time to a minimum.

4. How knowledge of the effect of size of crew can be applied to fire-fighting strategy is indicated by the following examples:

(*a*) It is more efficient to divide a crew into two (or more) crews and use each crew on a separate part of a fire than to use all the men in one crew. (This holds true unless the behavior of the fire itself indicates that all the men should be concentrated on one side.

Example: Fifty men are available to work a fire with 2 miles of perimeter rated *moderate* resistance to line construction. Using actual values found by the study and shown in the chart (p. 136) it will take 50 men in one crew 12.3 hours to work around the fire. By values in the same chart, two 25-man crews working simultaneously on two sides of the fire would do the same job in 8.2 hours, a saving of 4.1 hours. If it were practicable to place five 10-man crews around the fire so that they could all work simultaneously on separate fifths of the perimeter, they should complete the same job in somewhat less than 6 hours.

(*b*) Because the time spent in walking crews to and from the control line is nonproductive time and has the same depressing effect on per-man output of productive work as walking on the job, it follows that any reduction of walking time to and from the fire by use of motor equipment or camping on or near the control line offers very real possibilities of increasing the effective per-man output of fire fighters.

Scouting as an Essential Part of Fire Suppression.—When a forest fire gets away and runs wild, scattering its unpredictable pattern over ridges and canyons, sweeping, spotting, and fingering through a maze of jumbled fuels, there's a big control job to be done. If there are to be orderliness and efficiency in this job, information must be gathered from all parts of the fire and gathered fast. Otherwise crews are likely to be found working in long, narrow bays practically surrounded by fire, spending precious time on a relatively slow-spreading main fire while a spot fire rages parallel and just beyond them, and making dozens of other costly errors because of inadequate information. The usual obstacles in scouting may be expected—smoke, rough country, darkness, heavy timber, brush, and logs, but the fire boss is going to attack and his action will be based on the best information available.

Control work the first morning is often ineffective for lack of information. Thorough scouting throughout the night should provide details as to location and condition of the fire for the fire boss before daylight, so that he can properly equip and place his men. After the first morning the ground and aerial scouts should currently report changes, spread, spot fires, cover conditions, and progress in establishing control lines. Ground scouts should be properly equipped and their work planned in such manner as to enable them to be away from camp for a 72-hour scouting trip if necessary, reporting their information by radio.

With an 8-pound, ultra-high-frequency radio it is possible for a scout, working through a relay station perhaps, to contact headquarters at any time. Map data should be transmitted by the coordinate method. Messages should be concise, following an outline which provides for complete information, readily interpreted and correlated with messages from other scouts. It is also possible for the fire boss to determine conditions on any part of the fire at any time if proper distribution of scouts and radios has been made.

The streamlined scout should carry a 4-pound, down sleeping bag and concentrated food. His packboard should be provided with a collapsible fish-pole antenna so that he can operate his radio while moving along. The pack, complete with radio, bed, food, first-aid kit, canteen, headlight, map, compass, and notebook should weigh less than 30 pounds. It is well for the scout to carry a pulaski or light ax for blazing or hot-spotting. There have been instances where scouts have handled hot spots at strategic control points until help could be sent from the nearest crew.

Care must be taken with scouting units to avoid building up overrefined organizations. Additional scouting personnel, such as radio operators, draftsmen, recorders, and telephone men, should be used in accordance with existing needs. The size of the scouting organization should be reduced as soon as the active need for scouting is past in order to provide additional overhead for control-line work.

Scouting has always been a vital function of fire suppression. As plans are made to do a better control job on future fires, appropriate consideration should be given scouting as a service absolutely essential to large fire management.—L. K. MAYS, *Fire Control Planning, Region 6.*

A BRUSH-BREAKER FIRE TRUCK: THE TANK OF FOREST-FIRE WARFARE

Paul W. Stickel

Silviculturist, Northeastern Forest Experiment Station

The brush-breaker fire truck perfected by C. L. Cherry of the Division of Forestry, Massachusetts Department of Conservation, promises to revolutionize the method of controlling forest fires by means of mechanized suppression equipment. Developed upon the principle that the way to control fast-moving fires in oak brush and pitch pine stands is by direct attack, the brush-breaker fire truck can operate along the edges of a fire, regardless of the lack of roads or the presence of brush and small pole-sized trees. The brush-breaker is essentially an independently operating offensive unit, which, while it was evolved for the particular conditions on the pine-oak barrens of Cape Cod, should be useful in many other forest regions except in very dense large timber or on exceedingly steep terrain.

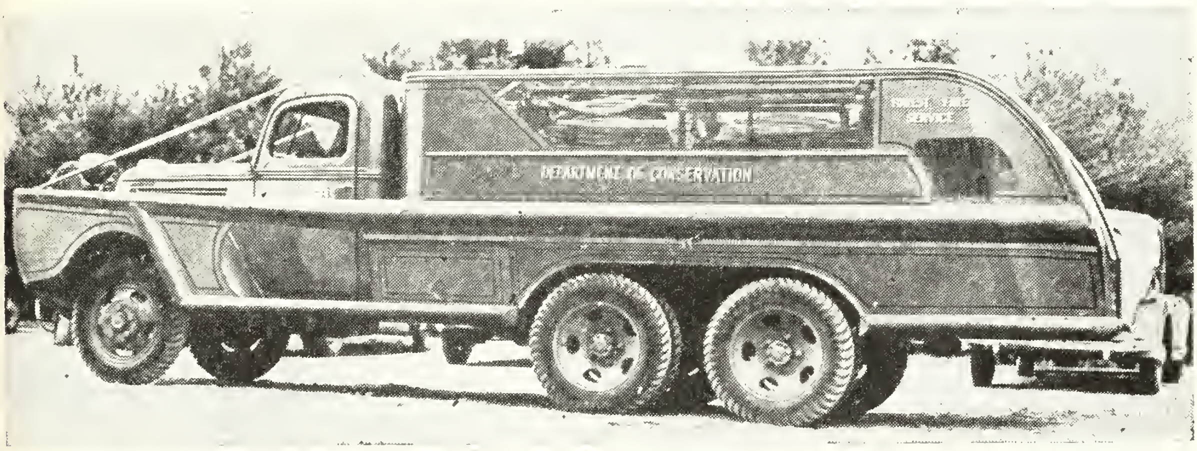
Mechanized equipment, especially of the automotive type, is rapidly altering modern warfare tactics. Next to aircraft, no modern weapon of war has played so important a role in this change as has the tank. This rapidly moving, independently operating, mobile fortress has become essentially an offensive unit that gives every indication of making the present-day battle one of open rather than trench warfare. Foresters may not realize it, but in the brush-breaker fire truck they have a "tank" that may materially alter the method of controlling forest fires. Under conditions wherein this newly developed suppression apparatus can operate successfully, it is no longer necessary to wait for a fire to burn up to a previously constructed control line; the fire can be attacked directly, and furthermore, it can be a running attack applied to any part of the edge of the fire.

As perfected by the Massachusetts Department of Conservation, this latest addition to present-day motorized forest-fire control apparatus is largely the result of the creative conception of Charles L. Cherry, supervisor of the Myles Standish State Forest. It has been the good fortune of the writer to witness the evolution of this fire truck; the initial model, chiefly locally constructed, is a far cry from the latest streamlined, massive piece of apparatus.

Specifications of the Brush-Breaker Fire Truck

The essential features of the brush-breaker fire truck are (*a*) the chassis and engine, (*b*) the front bumper and guard rails, and (*c*) water tank and pumping equipment.

Chassis and Engine.—The latest model of the brush-breaker truck is mounted on a regular V–8 Ford 95 horsepower truck chassis having a 157-inch wheel base, which has been equipped with a Marmon-Herrington all-wheel-drive, so that when in motion all 10 wheels, 2 front and 8 rear, are driving. The motor has an auxiliary transmission that gives the unit the advantage of both a set of high gear ratios for main-road travel and an exceptionally low set of gear ratios for operation in the woods, i. e., where no roads exist. The tires used are 32 by 6, 10-ply, of the traction-type tread that has been found to give maximum tractive ability to the truck. The truck engine is of the standard V–8 Ford type. Both it and the pump motor are water-cooled by means of a small auxiliary circulating pump driven from the rear motor. For this purpose water from the main tank is utilized. The headlights, siren, and flashing lights on the front of the truck are mounted on a hinged panel that can be raised and lowered by a vacuum cylinder controlled from the dashboard. This feature enables the truck operator to "duck" his lights out of the way of dead limbs or stubs, and in this manner prevent them from being torn away or broken.



Side view of latest model of brush-breaker fire truck.

When completely loaded with 1,000 gallons of water and the fire-fighting equipment mentioned later, the unit weighs 11½ tons. The weight has been carefully distributed, however, and more than meets the recommendations of the manufacturer of the chassis. As a matter of fact, the weight per axle of the truck is not as great as many conventional 250-gallon units.

Fully loaded, the unit has a maximum speed of 50 miles per hour on surfaced roads. However, in actual use 40 to 45 miles per hour is the usual top speed on main roads.

Front Bumper and Guard Rails.—The bumper or special crowding device mounted on the front of the truck has been so designed as to offer the minimum of resistance while knocking down or brushing aside trees and lesser woody vegetation; yet at the same time it offers the maximum protection to the chassis (see front-view illustrations). It consists of 3⁄16-inch sheet steel reinforced with 1 by 5 by 3⁄16-inch channel iron. Both the curvature of this plate and its attachment to the truck have been so designed that the initial impact and crowding action occurs as high from the ground as is practical. In this way, a minimum effort is needed to crowd down and ride over trees and brush. At the same time, there is a minimum of friction loss, both as the forest vegetation is pushed down and as the unit rides over it on the ground.

Attached to the sides of the front bumper are two curved, tapered flanges. These are so placed that they catch and force inwardly, away from the front wheels, the trees and brush that are crowded down, forcing these to pass under the truck. In this manner, side-thrust of the front wheels is prevented, enabling the driver to steer the truck easily, regardless of the density of the down timber and brush through which and over which the vehicle may be passing.

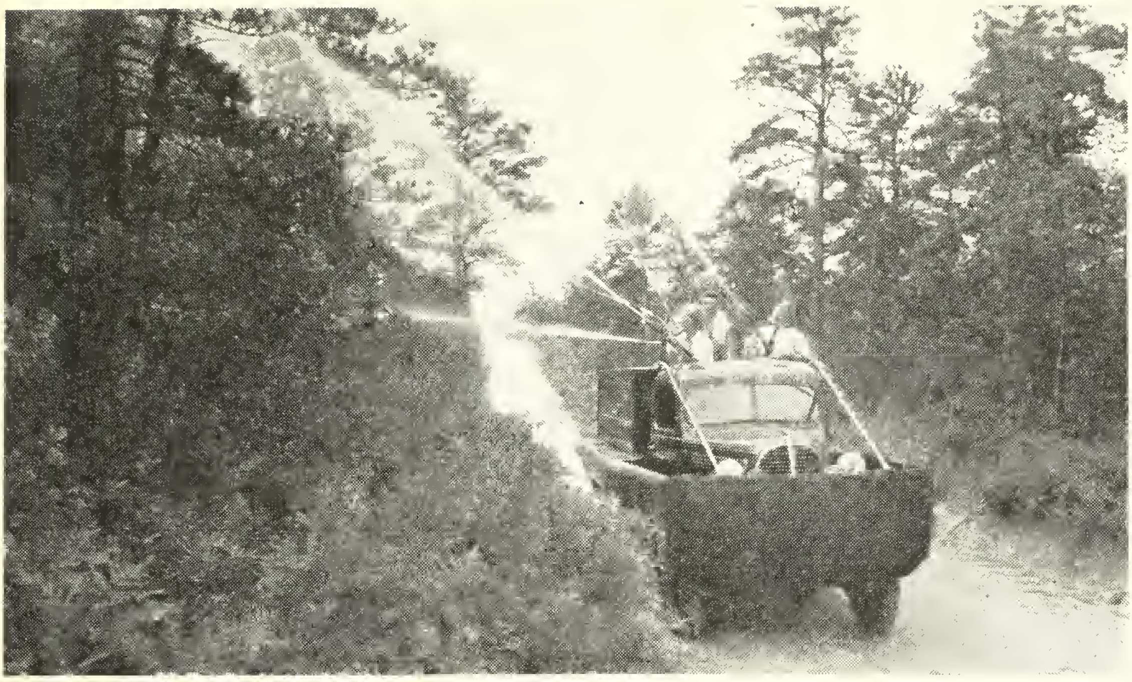
Two upper rub-rails consisting of half-round 3/16-inch steel welded to the back of 1- by 5- by 3/16-inch channel iron extend the entire length of the truck on either side from the upper side corners of the front bumper (see side-view illustration). These taper from a diameter of 3/16 inch at the front to 5 inches at the tank in the rear of the vehicle and are so placed as to give the truck a taper of about 2 feet in its entire length. This double taper provides for a gradual pushing aside of the trees that are not forced down by the front bumper, but which stand too closely together to permit clearance of the remainder of the chassis. Trees up to 10 inches d. b. h. have been spread apart easily to enable the truck to pass between them.

Lower rub-rails of the same construction as the upper ones extend from the front to the rear axles. These are placed at axle-center height and are set in from the outer edge of the upper rails, in order that contact with obstructions is made first with the upper rails. These lower rub-rails are indispensable in making it possible to execute short turns in heavy growth. The rails are constructed to withstand a calculated pressure of 4 tons per linear foot. The underframe of the truck is carefully reenforced, and the more vulnerable areas are further armored with steel plate.

The front view of the brush-breaker fire truck shows plainly the two 1-inch heavy duty chromium-plated pipes, or risers as they are called. These extend on each side from the upper edge of the front bumper over the engine hood to the top of the driver's cab. The function of these risers is to force upward the lateral branches of trees standing close to the sides of the truck which are not pushed over or forced aside, in order that the vision of the driver will not be obstructed.

Water tank and pumping equipment.—The body of the truck consists of a 1,000-gallon water tank. In order to keep the center of gravity as low as possible, provide correct distribution of the weight, and hold the surge of water to a minimum, this tank, constructed of 10-gage "Yoloy" steel, has the following specifications: Depth 3 feet, length 9 feet, and width 5 feet 6 inches. The over-all height of the tank from the chassis frame to its top is 2 feet 10 inches. The tank is divided into nine compartments, as follows: Two transverse partitions form three compartments, which in turn are further subdivided by two longitudinal baffle plates. Each compartment has individual discharge and refill openings, removable manhole covers, and vents.

The sides of the truck body extend 2 feet above the top of the tank to form a place for the hose line, and to provide space for the hose men to sit while using the nozzles. The combination steps, suction-hose sheaths, and rub-rails have been built as an integral part of the water tank and extend on the sides for the full length of the chassis.



Front view of latest model of brush-breaker fire truck.

Brush-breaker fire truck operating in oak brush and small-pole pitch pine stand.

The pumping units and motor, consisting of a Ford model-B type driving a triplex plunger-type pump of 50-gallon capacity per minute at 400 pounds pressure, are housed in a compartment at the rear of the body of the truck. Through experience with different types of pumps, it has been found that a small volume of water under a high pressure of 400 pounds or more, is at least 50 percent more effective in controlling the fast-running fires on Cape Cod than double the volume of water under half the pressure cited. A second pump of the rotary type, having a capacity of 200 gallons per minute at 100 pounds pressure, is used to fill the tank rapidly from any type of water supply. By means of a suitable clutch the plunger and rotary pumps can be driven separately by the Model B Ford motor or both can be operated at the same time by the motor.

The discharge from each tank compartment is valved separately, so that one compartment at a time is emptied. The usual procedure employed in emptying the tank is to pump off the compartments progressively from rear to front. This procedure holds the surge of the water to one compartment and at the same time keeps the distribution of weight where it should be. These are important features when driving such a heavily loaded piece of equipment over rough terrain.

An automatic pressure-regulator is used on the triplex pump that supplies water to the three high-pressure nozzles mounted on the forward deck, or fighting compartment, of the truck. These nozzles are of three sizes, namely, 3/16, 1/4, and 5/16 inches. They are of the new Bean Deluxe Spraymaster type, having a trigger control, and are capable of being regulated from a fog to a solid stream.

In addition to the high-pressure nozzles used on the forward deck, the truck is equipped with two 500-foot 1-inch live-hose lines and a 1,000-foot 1-inch dry-hose line. These can be used if the timber is too large and dense or the terrain is such that the truck cannot be driven along the edge of the fire. Furthermore, 1,000 feet of 1½-inch linen hose (dry) is coupled up ready for instant use on the deck rack. This hose line is intended for emergency use.

The brush-breaker principle is not necessarily confined to any special type or make of chassis, truck, or tractor. A heavier chassis may be used, and tanks of larger capacity can easily be constructed. However, the deterrent factor to increased size of the apparatus in the Cape Cod region is the inability of local bridges, bog dikes, flumes, etc., to stand up under the increased weight of heavier chassis and loads.

Operation and Performance of Brush-Breaker Trucks

Since no two fires present identical problems of control, no standard technique is possible in using the brush-breaker truck. As a general rule, however, the crew consists of around six men, a road or trail locator, a driver and helper who ride in the cab, and from two to three nozzle men on the forward compartment. The duty of the road locator is to scout out the way as close to the edge of the fire as it is possible to drive the truck, avoiding boulders, holes, and large trees. By a system of simple hand signals, he directs the driver along the best route selected. The nozzle men riding in the fighting compartment on the top of the tank just back of cab have at their disposal five nozzles ranging in discharge capacities of from 15 gallons per minute at 400 pounds pressure to 200 gallons per minute at 100 pounds pressure as follows:

1 nozzle 15 gallons per minute at 400 pounds pressure.
1 nozzle 25 gallons per minute at 400 pounds pressure.
1 nozzle 35 gallons per minute at 400 pounds pressure.
1 nozzle 50 gallons per minute at 300 pounds pressure.
1 nozzle 200 gallons per minute at 100 pounds pressure.

These are all charged and ready for immediate use. This feature allows the nozzle operators to use as little or as much water as the ever-changing conditions along the edge of the fire warrant. It also makes it feasible for the unit to follow the edge of the fire without stopping to apply more water to a given area than is absolutely necessary to extinguish or knock down the blaze at that particular point. When not in use, all the water in the lines is by-passed back to the tank by means of the pressure regulator. The action of the brush-breaker in knocking down the flames along the edge of a fire is followed by a mop-up crew equipped with hand tools and back-pack pumps.

Brush-breaker fire trucks have now been in operation for several years on Cape Cod. Their performance on many fires has more than met the expectations of their designer. Several case histories will illustrate the value of these units.

During the 1939 fire season, two brush-breakers were called to a fire. Upon arrival, they met several conventional pieces of fire apparatus that were leaving the particular area because of inability to get close enough to the fire to do any effective work. These conventional fire trucks had intended to line up at the next road, where it was hoped to intercept the head of the fire. The two brush-breaker trucks, on the other hand, simply took off into the brush, one along each flank of the fire.

Fortunately, before their tanks were entirely empty the brush-breakers found a bog near the edge of the fire where they quickly refilled. With full tanks the two units set out once again; the fire was soon encircled, and the head pinched out by simply following the flanks. After checking the fire, the brush-breakers moved out to the road ahead, where at least $50,000 worth of motorized fire-control equipment was found lined up waiting for the head fire to come out to the road.

Even more impressive is the record that the brush-breaker trucks established on a 1,606-acre fire occurring in 1938. This fire had an average rate of spread of 251 acres per hour, with a maximum rate of spread at the height of burning of 10 acres per minute. The total air-line length of the fire was 27,500 feet, or 5¼ miles; the total perimeter was 84,300 feet, or almost 16 miles. The effectiveness of the various types of equipment and methods employed in controlling this fire expressed in linear feet of perimeter extinguished was as follows:

	Feet
Backfire	22, 900
Brush-breaker tank trucks (3 used)	26, 000
Conventional types of fire trucks (20 used)	17, 900
Shovel crews	17, 500
Total perimeter worked	84, 300

The conventional trucks, i. e., units equipped with booster tanks of 100– to 200–gallon tank capacities with various sizes and types of pumps, were not designed to enable them to leave the roads to work the edges of the fire. The 20 units of this type worked an average of 5 hours each; all told, their average hourly output was slightly less than 180 linear feet of perimeter extinguished. The three brush-breakers operated an average of 6 hours each. In contrast, their average output was approximately 1,450 feet of perimeter extinguished per hour or eight times as much.

The brush-breaker fire truck is also having a profound effect on another phase of forest-fire control practice on the Cape Cod region. For years much money and effort have been expended in establishing an adequate firebreak system. First the areas were divided into square-mile blocks with firebreaks 40 feet in width around each block. With the advent of the CCC, these blocks were split into half-square-mile units, with an attendant doubling of the maintenance costs of the firebreaks. Elaborate fire-control plans, centering around these firebreaks, were evolved as the means of stopping fires, and as roads that could be used to work from in controlling fires. However, when the critical test came during 1938, 50 percent of these firebreaks were found to be useless as roads. In some cases, they even proved to be a direct hindrance, while in others, they were found to be dangerous to use for control purposes. Fires which readily crossed these firebreaks were, however, brought under control finally by brush-breaker trucks. Based upon this experience, there is every reason to believe that where brush-breaker fire trucks can operate successfully, firebreaks may not be needed except in rare instances. Even then, firebreaks need not be as wide or as well maintained as is necessary with the conventional type of fire truck. Costly firebreak construction and heavy annual maintenance charges can be brought to a minimum by using brush-breaker trucks.

In passing, the possibility of increasing the effectiveness of the unit as developed to date by using foam mixture instead of plain water should be mentioned. In regions where the surface water supply is limited, but where the ground-water level is sufficiently close to permit using the portable well-driving apparatus developed by the Michigan Forest Fire Experiment Station, a brush-breaker truck equipped with such a unit should prove to be a very efficient piece of forest-fire control equipment.

The Holst Tool.—A new addition to the long list of fire-fighting tools has recently been developed by M. L. Holst, formerly of Region 6, U. S. Forest Service. This tool has been given a thorough working-out in my department and I believe it will be of interest generally. The tool is similar to the council tool and is most satisfactory for fire-line construction purposes. It is constructed so as to take the standard adze-eye hazel hoe handle. Agencies using the tool in connection with adze-eye hazel hoes need carry but one type of handle in their tool boxes.

A special handle, similar in every respect to an adze-eye hazel hoe handle except in length, makes the tool more suitable for tall fire fighters, although the standard adze-eye hazel hoe handle is best for the average man. I would recommend purchasing the tools with the special handles, and using only the short ones when advisable on account of breakage and for fire fighters of small stature. Fire wardens who have seen this tool, especially those with fire trucks, are enthusiastic over the easy stowability of the new tool upon their vehicles. The tool heads with their sharp cutting teeth can be stored in a tool box, separately from the handles, thus providing safety for crew members. Arriving at the scene of the fire it takes but a few seconds to slip the heads on the handles.

It is both a cutting and a digging tool. One member of my department stated that for light brushing-out operations he would rather use it than a brush hook. It is usable in any fuel type suitable for the council tool and is believed to be better balanced and not as fatiguing as the latter. The short handle permits close grouping of crews on the line, especially where progressive fire-line construction methods are used. It is hoped that the Holst tool will be on the market in the near future.—ANNE C. ALLEN, *State District Forest Fire Warden, Rhode Island.*

THE STATHEM FIRE-FINDER DISC

PAUL STATHEM

District Ranger, Sequoia National Forest, Region 5, U. S. Forest Service

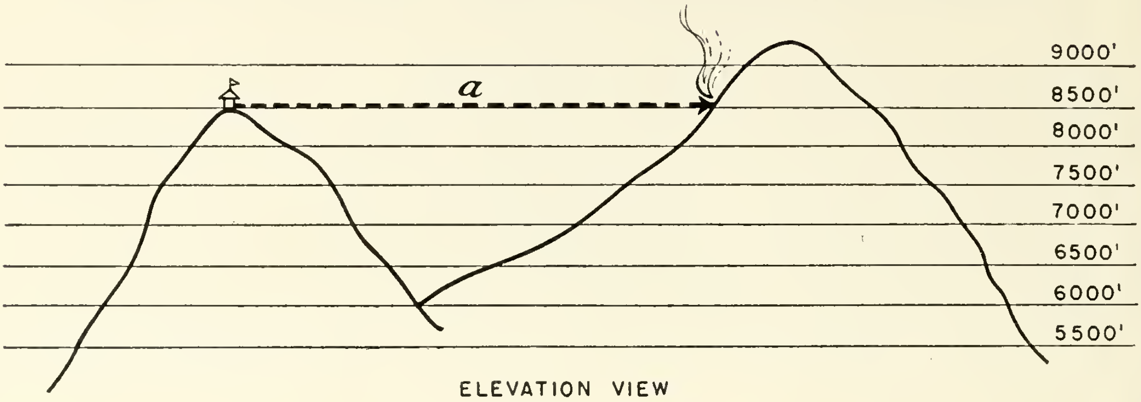
To know definitely, to be certain beyond the shadow of a possible doubt, that you have the exact map location of the spotted fire, is a fine beginning for suppression action on any fire. Conversely, to be in doubt, to be several miles off, is not only disheartening but costly in dissipated manpower, time lost, and acreage burned. Yet this uncertainty sometimes prevails when a cross shot cannot be secured from another lookout.

With the progress which has been made in detection planning and expansion in the installation of lookouts, the total high-hazard area visible to but one lookout has been greatly reduced, thus minimizing the no-cross-shot problem. However, we still are faced with the difficulties inherent in securing accurate locations for fires at night. After nightfall, when topography and distances are so deceiving, a dependable, mechanical means of fire location is sorely needed.

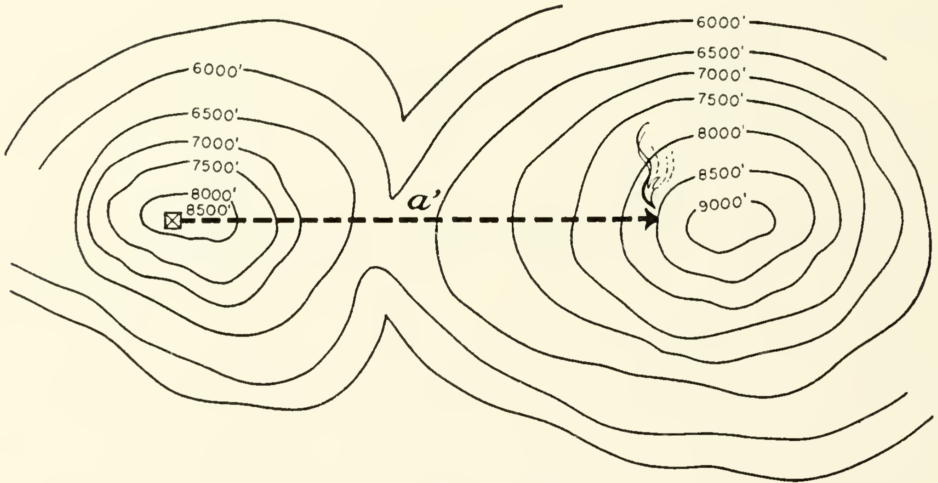
Confronted by such problems, we evolved a simple tool which provides for mechanical location of a fire quickly and accurately, with but *one line of sight.* Following is an explanation of the principle involved in securing this location from the one line of sight, as illustrated in chart I.

Our common sense and a glance at chart I tells us that the line of sight from the lookout to any given point can intersect with the ground at only one elevation. From our knowledge of topographic map reading we know that the elevation of the point of intersection of this line of sight with the ground can be read on the contour on the map, and that such point is then the map location of the object being sighted upon. Thus, for example, if we sight out from the lookout on a level line (vertical angle 0°), the first place at which our line of sight (line a) intersects with the ground is the same elevation as the lookout from which we are sighting. On the contour map, the intersection of this line of sight (line a′) with the first contour equal in elevation to the lookout from which we are looking is then the map location of the point being sighted upon.

Now, if we look out on a line of sight whose vertical angle is minus 2°, as shown in chart II, line b, the first point of intersection on the ground of the line of sight will have to be lower in elevation than the point from which we are looking. How much lower is mathematically related in a direct ratio to the distance that point is from you. (For mathematical theorem explaining this ratio see p. 155 of this article.) For example, for a minus 2° vertical angle, the loss in elevation is 138 feet for 1 mile; an additional 138 feet for 2 miles, making a total of 276 feet loss for the 2 miles; 414 feet in 3 miles, etc. Thus, if the elevation from which you are looking is 8,500 feet, on a minus 2° vertical angle line of sight, the first point seen along that line of sight, at 1 mile distant, would be 8,362 feet in elevation (referred to as *indicated* elevation); for a first point seen at 2 miles, 8,224 feet would be the point's elevation, etc.



ELEVATION VIEW



PLAN VIEW

CHART I.

The practical application of this principle of constant loss in elevation per mile can best be illustrated by an example based on chart II. Suppose the lookout man, Jones, on Bull Peak (elevation 8,500 feet) sights (along line b) a fire on one of the ridges across from him. He isn't sure which ridge, or how far distant it may be. His vertical angle reading is minus 2°. He then knows that if the fire is 1 mile away, its elevation must be 8,362 feet and this elevation will be so indicated on the map where the line of sight and the topography intersect exactly 1 mile from the lookout. Jones looks on his topographic map along the line of sight (line b′), checks 1 mile in distance on the tape scale of the Osborne fire finder and at that point he reads the contour line crossing the line of sight. In the illustration this contour line would read 7,700 feet, which does not coincide with the *indicated* elevation which must pertain if the point is to be that sighted on the ground. He then checks the countour reading at 2 miles distant, and would again find no coincision of *indicated* (8,224 feet) with actual (6,700 feet) elevation. By this trial and error method he proceeds along the line of sight until the first point of coincision is determined, which in chart II would be at 11 miles distant where the contour line on the map would agree with the *indicated* elevation of 6,979 feet. This point is the exact map location of the fire, and all that remains to be done is to read the location on the map in terms of legal subdivision.

Knowing then that it was possible to secure an accurate map location for a fire with but one line of sight, the next problem was to develop a ready method of applying the principle of constant loss in elevation.

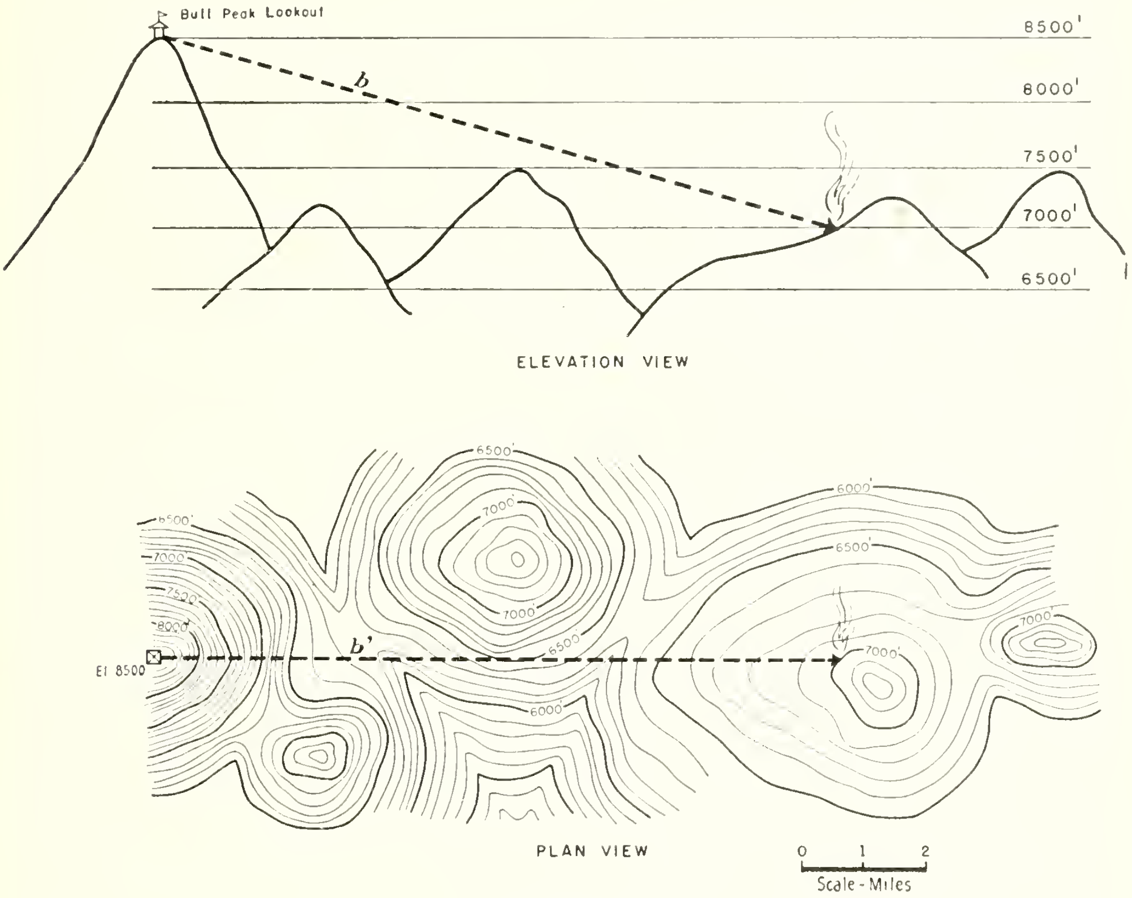


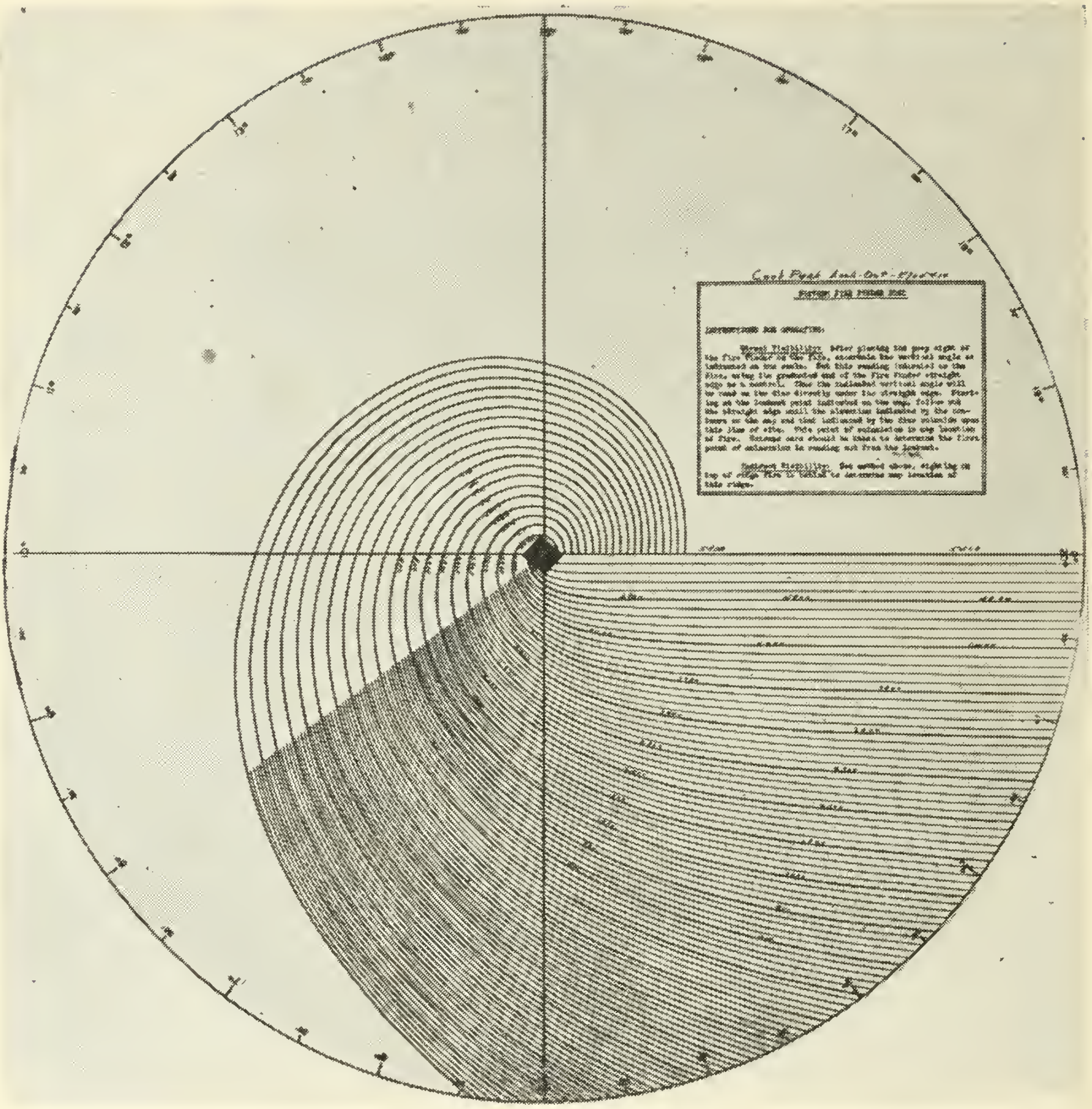
Chart II.

It is evident that it would be possible by the more or less prolonged method of profiling to determine the map location of the point being sighted upon. This took considerable time and was far from foolproof due to the lack of any such experience or training of the lookout along these lines, but, by the trial and error method, and, with a set of profile tables to show *indicated* elevations, it was possible to determine fairly accurately the map location of the point. This method did save the smoke chaser many weary miles and did put him on the fire in less time than had been the custom but it made a sorry story of report times. What we needed was a handy, precalculated means of applying the vertical angle. Furthermore, this tool must be easily manipulated by relatively untrained observers in order that the fire location be secured and reported in the shortest possible time, certainly within the regional standard of 2 minutes. This we accomplished in the celluloid discs pictured on p. 152. For a detailed story of its development see the last pages of this article.

Operating Instructions

Superimpose the celluloid disc upon the topographic map on the fire finder, as shown in picture on p. 153.

For direct visibility: After placing the peep sight of the fire finder on the fire, read the vertical angle. Revolve the disc until the desired



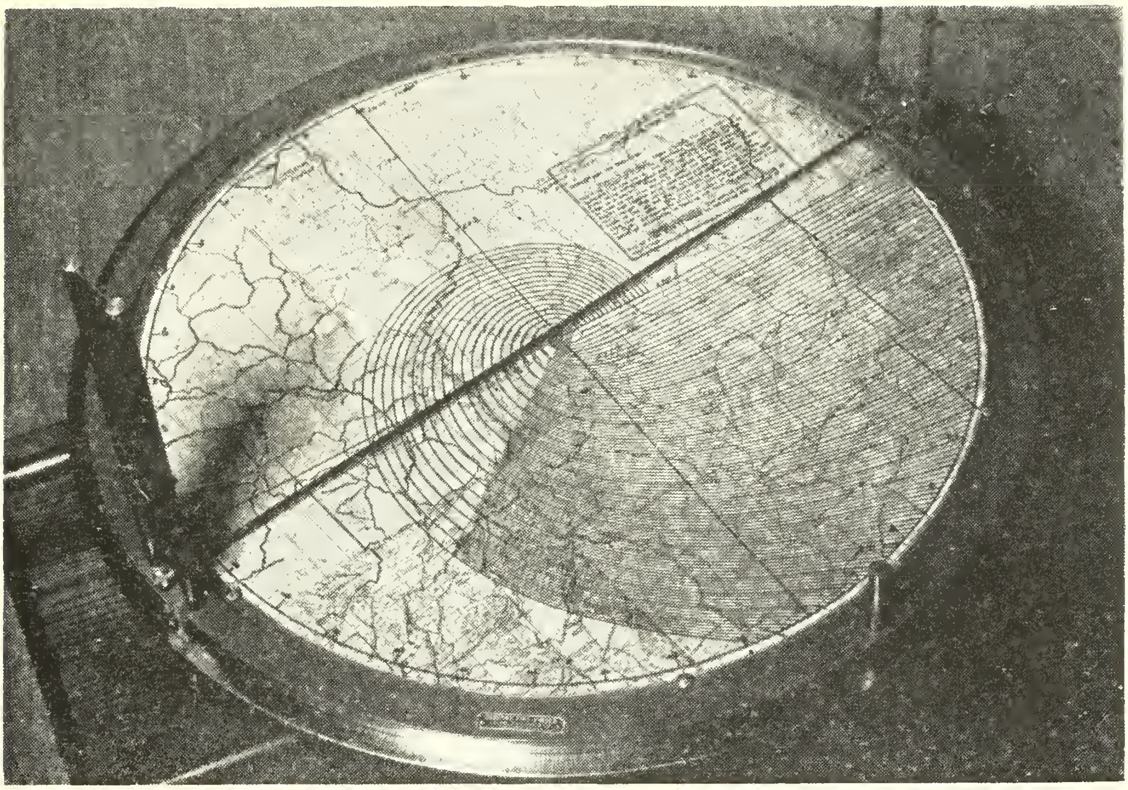
Celluloid disk alone.

vertical-angle reading is directly under the graduated end of the fire finder's straightedge (or scale tape). Starting at the lookout point on the map, follow out the straightedge until the elevation indicated by the contour on the map and that indicated by the disc coincide upon this line of sight. This point of coincision is the map location of the fire. Extreme care should be taken to determine the first point of coincision in reading out from the lookout.

Indirect visibility: Use method above, sighting on top of ridge fire is behind to determine map location of this ridge.

Considerable success has been realized with the use of this instrument, even in its present form. A disc was used for most of the 1939 summer field season and several fires were accurately located independently by the lookout. The first fire to be located was approximately 18 miles away and was a single tree. With the use of the disc, the guard was sent directly to the fire without loss of any time for searching. The guard had been instructed to check the location in detail as to its relationship to surrounding topography. His report was that the location as originally given was within 100 yards of the actual location of the fire.

Discs were prepared for each lookout on the Sequoia National Forest and used in the 1939 season. However, the discs were received too late for group instruction at the guard training camp, which resulted



Celluloid disc in use on map.

in varying levels of ability in their use. Even so, a number of lookouts became very proficient in the use of the disc and a number of independently secured locations were turned in during the summer season. A back-country guard who has had the same station for 14 years made the statement that never before had the locations been so definite and accurate in his entire experience. This statement was made after a season of lightning concentrations of unusual intensity.

Mathematically, the disc is just as accurate as the map upon which you are working, and that accuracy we have found is sufficient to give us dependable locations. However, at present the use of the disc is limited by the very nature of its physical construction. These difficulties are being remedied. The disc now in use is made up of two celluloid circles glued together, the bottom circle is a very light celluloid to provide visibility and on this circle are photographed the lines and figures of the scale. Both lines and figures are at the present time so large that they impair vision on the map. Attached to the light celluloid circle is a heavier one which serves a dual function of protecting lines on the lighter one from wear, and lending rigidity to the disc. This extra thickness of celluloid limits the vision still further. What is needed is a light rigid transparent material upon which the lines and figures can be finely photographed or etched. The discs used last summer cost $4 each and it is believed that a more satisfactory type can be developed within or below that cost.

The type of map used on the fire finder plays an important role in the use of the disc. It has been found that culture should be held to the barest minimum, as the superimposing of inked-in trails, roads, guard-district boundaries, etc., only adds a confusion of lines and is not necessary to the lookout since he needs only to secure an accurate location by legal subdivisions. The dispatcher is the only man concerned with the culture information and of course he has a map showing such detail. (It will be noted that more culture than necessary appears on the map in pictures.)

If the main contour subdivisions (500 feet) are inked to make them stand out sharply, use of the disc is facilitated; also the number of numerical readings on the contour lines should be increased above that normally supplied on our standard maps.

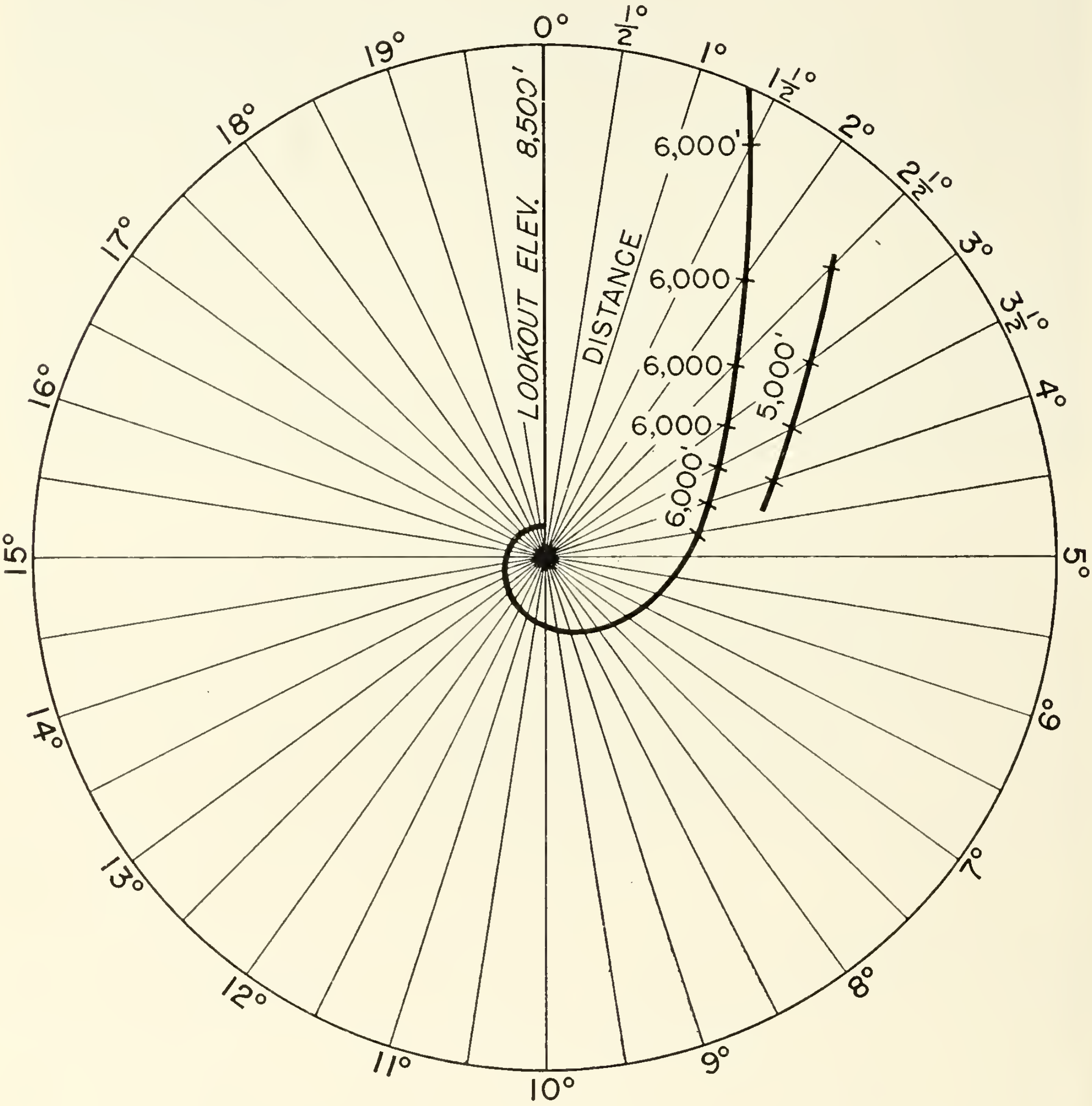


Chart 3.—Illustrating method of adapting scale sticks (see illustrations that follow) to the disk. Here the elevation of the lookout is used as a starting point in the common center for all scales, and each interval on the various lines indicates a loss of 100 feet in elevation.

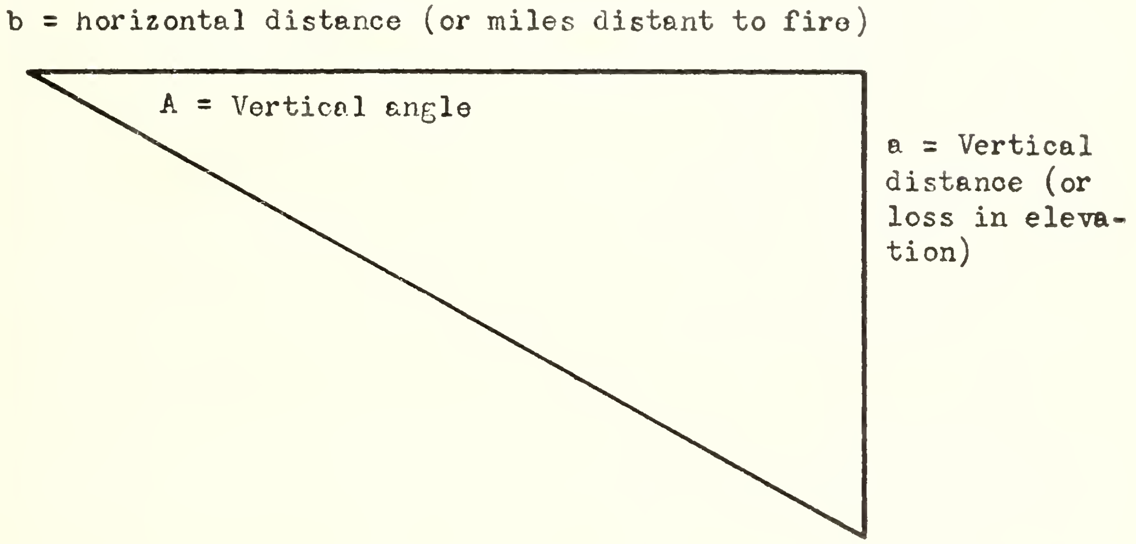
A suggestion which we are trying out next summer, is that of using a color matching scheme on the standard map and disc. For example 5,000-foot contours on the map and on the disc would be colored red, 5,500-foot contours colored blue, and so on. With this method, the point of coincision of the elevation indicated on the map and that on the disc is more easily identified.

As our experience in the use of the disc grows, other short cuts may appear, but one thing is certain—in all but flat or low rolling country the disc is a useful tool in fire detection, night or day.

Supplement

Statement of mathematical theory

The mathematical basis for the principle of constant loss in elevation per mile of distance, is found in the geometric theorem Tan A=a/b


b = horizontal distance (or miles distant to fire)
A = Vertical angle
a = Vertical distance (or loss in elevation)

In the solving of the right triangle, Tan A=a/b, any point being sighted upon will have only 1 angle A which establishes a definite relation between b and a, so if for a given reading b=20 and a=2, if b was increased to 40, a would necessarily increase to 4, or vice versa.

Development of the Stathem Disc

The explanation that follows, a description of the steps followed in arriving at the completed disc, is offered for what value it may have in making the disc more understandable.

The development of this disc went through four more or less distinct but closely related stages before the final disc was secured. They were as follows:

1. *Use of profile tables*—

Portion of a profile table: By interpolating and trial and error method, the map location of the point being sighted upon can be located

Vertical angle	Distance in miles														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Difference in elevation														
1°	46	92	138	184	230	276	322	369	415	461	507	553	599	645	691
1½°	92	184	277	369	461	553	645	738	830	922	1, 014	1, 106	1, 198	1, 291	1, 383
2°	138	277	415	553	691	830	968	1, 106	1, 245	1, 383	1, 521	1, 659	1, 798	1, 936	2, 074
Etc															

By the use of profile tables, it was possible to obtain a fairly definite map location of a spotted fire by going through the following steps:

a. Sight the fire finder (straightedge automatically falls on line of sight) and ascertain the vertical angle which, let us say, happened to be minus 2°.

b. Estimate the distance to the fire and read this distance out on the Osborne fire finder straightedge.

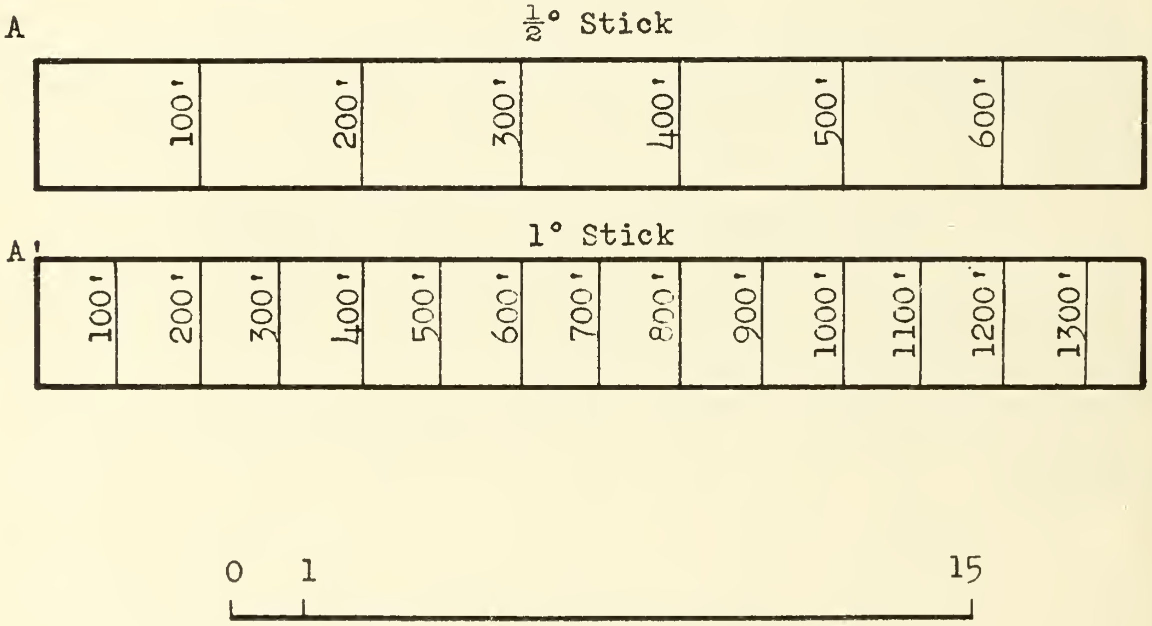
c. Check the indicated elevation on the map at this point where you estimate the fire to be and subtract this elevation from that of the lookout from which you are sighting. Let us say that the estimated fire location is 5 miles distant, its elevation is 7,000 feet and the elevation of the lookout is 8,500 feet. The loss is 1,500 feet.

d. Checking the profile table for the reading you find that the *indicated* loss for that angle is only 691 feet for 5 miles, and your estimate of the distance is incorrect.

e. The process is repeated on a trial and error basis until you find the correct distance, which is that distance where the loss indicated on the map agrees with that in the table.

Obviously, this method was much too cumbersome and time consuming.

2. *Use of a profile scale.*—Scale sticks were prepared from the profile tables, with even 100-foot losses being plotted on the same scale as the map, indicating losses in elevation for any given angles for any given distance. (See illustration.)

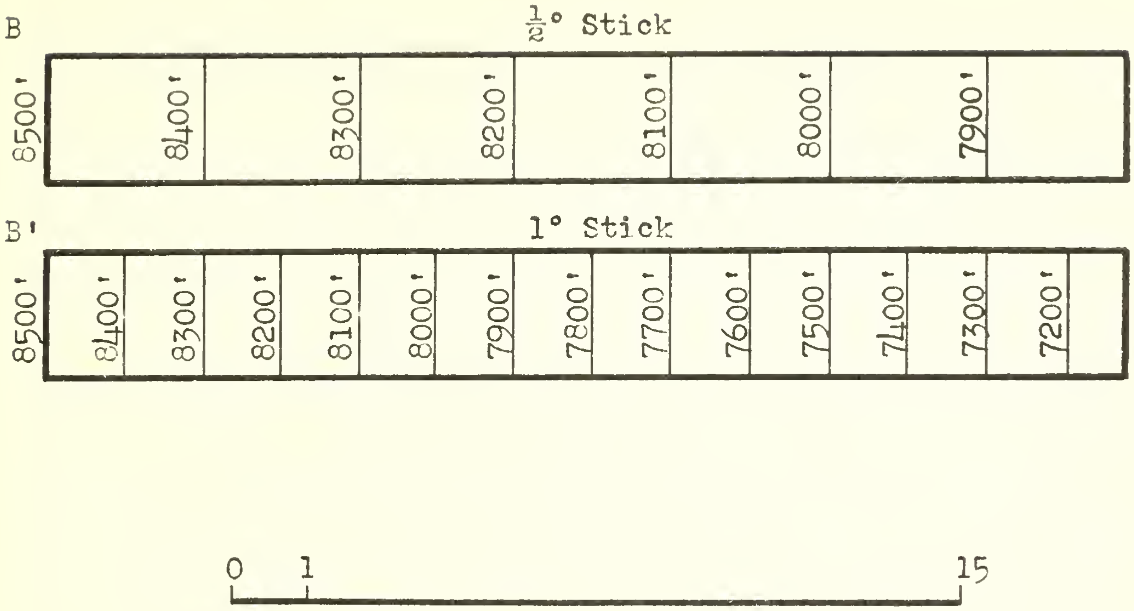


Scale sticks prepared from profile tables.

The scale sticks were then adapted to specific lookouts with true elevations in respect to the elevation of the lookout being substituted for loss-plotting. Thus the figure on any line is the elevation of the lookout minus the loss indicated on the scales.

In this method the lookout, after securing line of sight and vertical angle of, say 2°, selects the proper scale stick and places the scale along the line of sight. The first place that the elevation indicated on the scale coincides with the true elevation indicated by the contours on the map is the map location of the point being sighted upon.

3. *Modified disc system.*—It is evident, though, that the lookout would need a great many scale sticks to use this method, in fact, 120 would be needed if the vertical angles were read in 10-foot intervals



Scale sticks adapted to specific lookouts.

for 20°. Thus we still had a cumbersome device and it was desirable to combine on one instrument the 120 separate scales. A transparent object was necessary in order to permit the operator to read through on to the map and a disc seemed most appropriate for its form, inasmuch as all scales have a common origin at the center of the disc. The disc could be placed on the fire finder map and revolved quickly to enable the operator to select the correct degree scale. Furthermore, if the disc was of transparent material it could be left on the map at all times. The process of finding the map location is the same as with individual sticks.

4. *Stathem Fire Finder Disc.*—It was apparent upon completing the disc referred to that this could be still further simplified by the elimination of the lines for the scales, leaving only a fragment for indicating angles on the edge of the disc. Then too, the points of equal loss in elevation on the various scales could be connected together with a curve. Thus, it was possible to read the disc for any angle or fraction of any angle and interpolation was greatly simplified (see photograph of the completed disc).

Governors on Fire Trucks.—We observed that a governed fire truck motor will not pick up enough r. p. m. or power to pull its load through the sand and brush on this forest. A transmission governor might prove much more satisfactory because it would affect only the speed of the vehicle as compared to the type in use on carburetors at present which limits the flow of gas to such an extent that often the truck will not quite pull its load in low gear. The first time the Dodge fire truck stuck I am sure that 5 to 10 miles increase in motor speed would have pulled it out, as the truck was not digging in, but the motor was getting just enough gas to overcome the inertia, the truck pulling forward just a little and then stalling the motor before it could really get rolling. I recommend a study of this problem by appropriate officials.—*Report by District Ranger J. W. Cooper, on the Glenn Branch Fire, Ocala National Forest, 1939.*

THE SILK-SCREEN STENCIL FOR PRINTING AZIMUTH CIRCLES

Vincent V. Colby

Assistant Exhibits Designer, Region 3, U. S. Forest Service

Application of azimuth circles to fire-control maps may be completed in a few minutes with a silk-screen stencil instead of drawing them individually by hand or using other processes. Any shade of color may be used, even metallic, if desirable for better vision. The lines and numerals stand out in high relief, are nonfading and permanent.

The silk stencil was used by the writer as long ago as 1912 when it was desired to find a better way for applying letters on felt. A common netting material was stretched on a wooden frame. The letters were drawn with pencil on this stretched netting and the space around and between the letters was painted out with brush and shellac. This essentially was the stencil.

After many experiments a paint of the right consistency was found and with the help of a flat wooden scraper faced with rubber, the paint was scraped across the netting material. In this manner the paint was squeezed through the open spaces (the letters) and, upon lifting the stencil, all letters were found to stand out cleanly in high relief on the felt.

Following this early work improvements were made and there was then completed a better method whereby a fine-mesh silk was used and in combination with a photo gelatine solution.

The silk-stencil method became popular over the years and various patents were obtained, all of which, however, were based on the principle of squeezing paint through a cloth mesh.

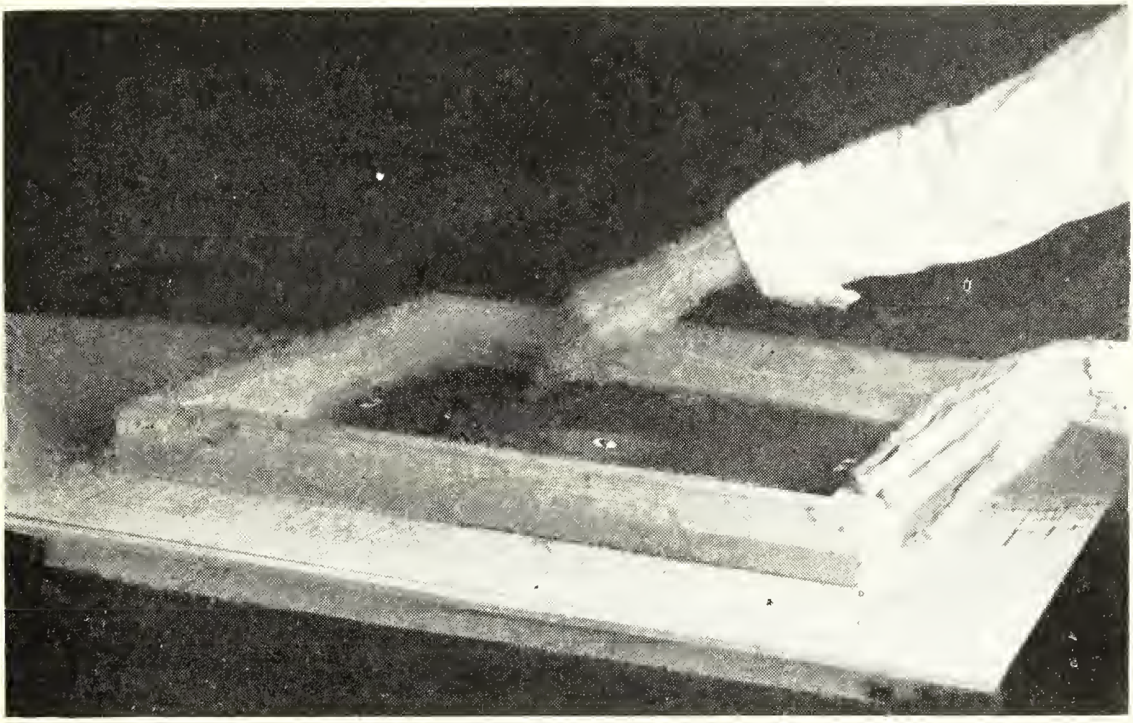
Today printing with silk screens is widely used but, curiously, even now the method has not been fully exploited. For instance, carbon tissue, whereby a sensitized gelatine sheet is exposed to light under photographic film and transferred onto the stretched silk, came out only a few years ago and, while used in industry, is still a sort of "hair-trigger" proposition for the reason that the very thin film of gelatine adhering to the silk does not stand up well under production.

Here in Region 3 the writer is producing stencils with a tissue of his own make from which over ten thousand copies may be printed. From such a stencil the finest of pen lines are reproduced cleanly and the requirement is merely that such lines be black (opaque) when originally drawn.

For reproducing pen drawings, maps, etc., in limited quantities the method is simple and economical since there are no plates to be made.

Place a clear sheet of celluloid over a preliminary pencil sketch and execute the drawing on this celluloid with pen and ink. This drawing is then brought into contact with a sensitized tissue which, after treatment, is transferred onto the stretched silk. This is the stencil and it is based on the same principle as the first commercial stencil made in 1912.

However, until recently there has been one fault which prevented the use of even this fine grade of stencil for printing items requiring extreme accuracy such as the azimuth circle on fire control maps.



Method of applying paste paint to stencil.

On such maps any distortion by reason of shrinkage and consequent distortion of the protractor would make the latter useless. There was always some distortion perhaps not very important when a pen-and-ink illustration had to be printed.

This has been overcome. There is no distortion of the asimuth circle and the stencil can be placed onto the printed map exactly where wanted. For this purpose the stencil is provided with a hole in the exact center for placing over the spot where the fire lookout is located on the map. Four more holes or windows rather are placed outside of the circle in such a way that each will cover a point of the compass. Each of these windows is provided with a fine hairline which coincides exactly with the small pencil lines previously drawn onto the map itself. Accuracy is assured by placing the stencil in position onto the printed map in this manner. Now a bit of heavy paste paint, any color, is dipped up with a small piece of stiff rubber and with a circular motion the paint is scraped over and around the circle (see illustration). The stencil is now lifted and it will be found that the circle is imprinted cleanly on the map. As an added safety factor the map may be previously coated with a spray of clear lacquer (duco) just in case the printing, through any accident, is faulty. With a small rag, moistened with turpentine, the print may be easily removed.

The finished print will dry in about 4 hours and by spraying on another coat or two of the same transparent lacquer the map is completely waterproofed.

With the silk stencil a print can be made on any flat surface not only on paper but cloth, leather, oilcloth, or other similar materials.

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Volume 4 Number 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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The value of this publication will be determined by what Forest Service officers, State forestry workers, and private operators contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management; theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire-fighting methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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A STUDY OF THE VOLUME AND LOCATION OF THE FIRE LOAD AND THE DETERMINATION OF AN EFFECTIVE PRESUPPRESSION ORGANIZATION TO HANDLE IT.

P. D. HANSON, *Senior Forester, Region 5,* assisted by I. C. FUNKE, *Assistant Engineer,* and E. L. TURNER, *Junior Forester, U. S. Forest Service.*

One of the important things needed in forest fire control is a body of tested theories and methods for determining the number of presuppression men to employ and where to station them within a protection unit. The California Region has put originality and much work into an effort to develop something worth while along this line. The problem is not an easy one, and it would be surprising if the following article is not open to criticism at various points. Nothing could better promote the development of the needed theories and methods than a general discussion in Fire Control Notes of various angles of the logic and implications of this sample of what the California Region has done.

In transmitting the article, the regional forester writes:

"This particular article is a copy of the report of the study made for the Plumas National Forest and was selected at random from similar reports of studies prepared for the 12 northern California fire forests. Studies were also conducted on the four southern forests, but these followed a different procedure than that employed in the north.

"The presentation in this form, as the study actually applies to a unit of land, appears preferable to a presentation of the general procedures followed.

"The study embodies principles of previous planning developed chiefly in this region, including the determined travel time standards for the various cover types, the procedure of competing stations with each other as used in detection planning, and procedures and results obtained in transportation planning.

"The study is the result of an appreciation of need for some better method to evaluate fire business, so that a comparison between forests, ranger districts, or fireman units could be made. It has been a help to us in planning financial estimates, placement of crews, and equipment.

"With respect to the applicability of the scheme to other regions, it might be well to mention that a prerequisite to this study is rather sound information on travel time standards, preferably for rather large areas on which the fire characteristics are relatively similar. If these standards are available and area boundaries decided upon, it is a simple though admittedly time-consuming operation to compute the rate of perimeter increase of the free-burning fire from the individual fire reports, and the resulting average rate for all fires in the area concerned. After this is obtained and some simple techniques mastered, the study proceeds rapidly."

. Objectives.

This study is an integral part of the Nation-wide fire replanning roject and has as a main objective the determination of an effective resuppression organization of both personnel and equipment required to handle the fire business and, particularly for this region, to bring that part of the whole fire-control system up to a level more commensurate with the present development of the transportation facilities.

In order to obtain the main objective mentioned, it was necessary—

1. To devise a method of measuring forest fire business as it is reflected by the small free-burning fire and to determine the location and volume of this business within the forest.
2. To consider and to provide for changes in the location of the fire business which may be anticipated in the future as compared to the past.
3. To determine the best locations for presuppression stations to most effectively and economically treat the fire business, as previously determined, selecting the locations on the basis of coverage of fire business within prescribed time limits through use of the existing road and trail systems.
4. To consider and prescribe treatment where practical for areas not reachable within reasonable travel time limits.
5. To determine desirable size of crews for initial attack.
6. To determine the best locations for tank trucks.

II. Procedure Employed.

1. *To devise a method of measuring forest fire business.*—The potential fire perimeter in chains at the end of one hour of free-burning conditions, or in other words the rate of perimeter increase, was accepted as the unit of measurement of fire business. To this was applied the term "perimeter unit."

For any area under consideration it is possible to measure the number of perimeter units if the average rate of perimeter increase and the number of fires which have occurred are known, since the product of rate of spread in chains per hour multiplied by number of fires results in the number of chains of fire perimeter which occur during the first hour that fires burn.

To obtain this, the rate of perimeter increase in chains per hour between discovery and arrival of the suppression force was calculated for all fires which occurred during the seasons of 1925 through 1937, inclusive.[1] All fires which did not spread, such as ignited snags, houses, and camp fires, were rejected in the process. The average rate of spread for those fires that had spread associated with them was computed for each of the major travel time zones on each forest. The zones referred to were those mapped and used in the transportation planning project for each forest. Travel time standards applicable to each zone will be discussed later.

Fire occurrence spot maps covering 10 years of man-caused and 20 years of lightning-caused fires were plotted. Each lightning fire was given the weight of one-half fire in order to keep the data on an even 10-year basis. With this basic material of rate of spread and number of fires in combination, it was possible to apply a numerical measurement to the fire business for any forest, ranger district, or guard unit desired. Each fire on the spot map was assigned the average rate of spread of fires on that area, which introduced a slight factor of safety and accounts for the term "potential fire perimeter" when referring to the definition of perimeter unit.

---

[1] A cooperative project with C. A. Abell, California Forest and Range Experiment Station.

The unit of perimeter was used as a measurement rather than the corresponding man-hours necessary to control the unit of perimeter, because rate of line construction was found to be so dependent on such things as fatigue, size of crew, use of machinery, etc., that more reliable comparative figures could not be obtained through its use. This factor was taken into consideration through the application of judgment in manning positions.

2. *To provide for changes in the location of the fire business.*—Changes in the location of fire business are chiefly effected by changes in industrial occupancy. Anticipated changes are, of course, not subject to measurement. The matter was given consideration by applying the best judgment available in the selection of presuppression stations by forest personnel.

3. *To determine the best locations for the presuppression stations.*—As a result of the study by Show and Kotok [2] which prescribed travel time standards for the various major cover types in northern California and as part of a previous transportation planning project, all forests were zoned into logical cover type zones having travel time standard applied to them of 30, 60, and 120 minutes, respectively. These were the zones previously referred to for which the average rate of spread was computed.

Templets, or transparent maps, were prepared, showing the area covered from each potential presuppression station studied, within the prescribed travel time limits for the zone concerned. The number of perimeter units covered within time limits for each station was then computed. In tables to follow, this figure is referred to as the station's "gross value" in perimeter units.

After the gross value was computed for each station, the stations were placed in competition with each other, on the basis of their coverage of perimeter units, with the objective of building up that combination of stations which could most effectively cover the fire business within time limits and with as little duplication as possible. Procedure employed followed that used in a previous study of detection stations and described in U. S. D. A. Circular 449, entitled "Planning, Constructing, and Operating Forest Fire Lookout Systems in California," by Show and Kotok. Briefly, this consisted of selecting the station having the highest gross value and reducing the gross value of all other competiting stations by the amount of the coverage mutual to them and the first station selected, then selecting as successive stations in the system those that add the greatest perimeter unit coverage to the coverage of stations already selected. The net amount added by each station is called its "contributed value" to the system. (Tables to follow in referring to these figures use the term "contributing value" or "contributed station coverage.")

Technique of computing competition requires preparation of a composite map of station coverages from which a master sheet is prepared. From this sheet selection of a system of stations may readily be made.

---

[2] The Determination of Hour Control for Adequate Fire Protection in the Major Cover Types of the California Pine Region, U. S. D. A. Tech. Bul. 209.

4. *To consider and prescribe treatment where practical for areas not reachable by a suppression force within reasonable travel time limits.*—Each such area was considered generally on the basis of fire prevention as being the only possible positive treatment. Provision for the necessary personnel was included in the prevention plan.

5. *To determine desirable size of crew for initial attack.*—Compilations for this study were handled under the direction of C. A. Abell, associate silviculturist, California Forest and Range Experiment Station, in cooperation with the author. The resultant report will be the subject of a future publication. The study shows clearly the necessity for crews of 5 to 6 men frequently placed in areas on which the average rate of spread is in excess of 12 chains per hour. Crews of from 3 to 4 men are required where spread conditions average 6 to 8 chains per hour. The reinforcing action of the second crew is essential to satisfactory performance.

6. *To determine the best locations for tank trucks.*—For each forest a map was prepared showing the area within 500 feet of all roads and within 500 feet of all places that a loaded tank truck could reach, traveling across country. This area was considered as the zone of influence of tankers.

The perimeter units on this area subject to this treatment were computed for the forest as a whole and for each of the proposed presuppression stations. This provided a basis for planning this type of equipment. See tables 3 and 4.

III. Definition of terms used in tables to follow.

1. *Perimeter unit.*—Each chain increase in perimeter per hour for free-burning fires is a perimeter unit.

2. *Perimeter unit value.*—The product of the number of fires that have occurred in an area over the 10-year period multiplied by the average rate of perimeter increase in chains per hour for fires that have occurred in the area concerned.

3. *Gross value.*—The total number of perimeter units on an area which can be reached within prescribed travel time limits from the station concerned.

4. *Contributed value.*—The number of perimeter units that can be covered from a station within travel time limits and which have not already been covered by stations ranking higher in the system.

5. *Unduplicated value.*—The number of perimeter units covered within time limits and common only to the one station under consideration. This applies only to coverage from the final selected system.

6. *Initial attack value.*—The number of perimeter units in the area which can be reached more easily and quickly from the station concerned than from other stations in the selected system. This rating is subdivided into perimeter units which can be reached within time limits and those that require extended travel time to reach.

IV. Application to the Plumas National Forest.

1. In applying the foregoing to the Plumas National Forest, the average rate of initial perimeter spread of fires occurring in the various travel time zones was determined to be as follows:

Zone	Maximum allowable travel time (minutes)	Perimeter spread (chains/hour)	Basis number of fires
I	30	16. 9	698
II	60	10. 1	366
III	120	6. 5	65

The area, the number of fires, and the perimeter units in each travel time zone are shown on table 2 of this report.

2. Since the fire occurrence considered is on a 10-year basis, the ratings obtained by multiplying occurrence by the proper rates of spread are also on a 10-year basis, i. e., perimeter unit ratings are for 10 years.

3. A conference held in San Francisco on February 2, 1940, was attended by the regional forester, members of his staff and the following forest personnel: D. N. Rogers, forest supervisor; John Grey, assistant forest supervisor; Keith MacDonald, fire chief; and Ernest L. Turner, fire replanner. At this conference the results of a preliminary study were presented. A series of maps, overlays, and tables was used in this presentation to show the presuppression value of each location studied. Selection of locations to be manned by presuppression forces was influenced by administrative and other considerations as well as the computed perimeter unit ratings. The tables, some of which have been recomputed by the elimination of certain stations, are included in this report.

Decisions made at the conference regarding the selection and manning of stations and the distribution of various sizes of tank trucks are shown in table 4.

Notes on the selection or rejection of stations which were influenced by factors other than their perimeter unit ratings follow:

Portola.—The fire occurrence as shown on the maps for the 10-year period concerned in the immediate vicinity of Portola was not considered to be a fair representation of conditions as they now exist. These fires, for the most part, are small camp fires and smoker fires started by itinerants along the railroad. The trouble has now been greatly reduced by a program of hazard reduction. Therefore, it was decided to consider a reduction of this number of fires by 75 percent for the purpose of this study.

Mooretown.—This station in reality is more important than its contributing value indicates. It is in the center of an area previously protected by the State. Because of this, its ratings as shown in this study are based only on fires upon which the Forest Service took action and the records of which were in the files. If records of the total occurrence for this area had been available, a conservative estimate indicates that Mooretown would have had a contributed value of approximately 500 perimeter units with 50 percent of them being unduplicated. All this area falls within the boundary of the Raker Act.

Cascade guard station.—Because a large area requiring one-half hour travel time will be opened up by the completion of the Millsap Bar Road, this station was approved. It covers more of this area within time limits than any other station. Also it has prevention value.

Boulder Creek guard station.—Although its contributing value is low, it was retained in the system on the basis of its importance from a prevention standpoint, especially during the hunting season, and also of anticipated logging activity in that vicinity.

Prattville.—Although it has a higher contributing value than some of the stations selected it was rejected on the basis that crews at Almanor Dam and at Chester (a Lassen station) could sufficiently protect this area.

Black Mountain lookout.—This station is classed as a primary lookout in the detection plan but has been used as a lookout-fireman. Its continued use as a fireman will not be necessary in the planned fire control system.

Bear Ranch Hill lookout-fireman.—This was left in the system for its detection value to the Lassen Forest and now becomes a primary lookout.

Red Hill lookout-fireman.—Although its contributing value from a suppression standpoint was zero, its detection value was considered enough for it to remain in the system.

Red Mountain lookout-fireman.—This station remains in the system as a lookout-fireman, primarily for detection.

Three Lakes lookout-fireman.—This station's contributing values in both suppression and detection were so low that it was dropped from the system.

V. Maps Prepared.

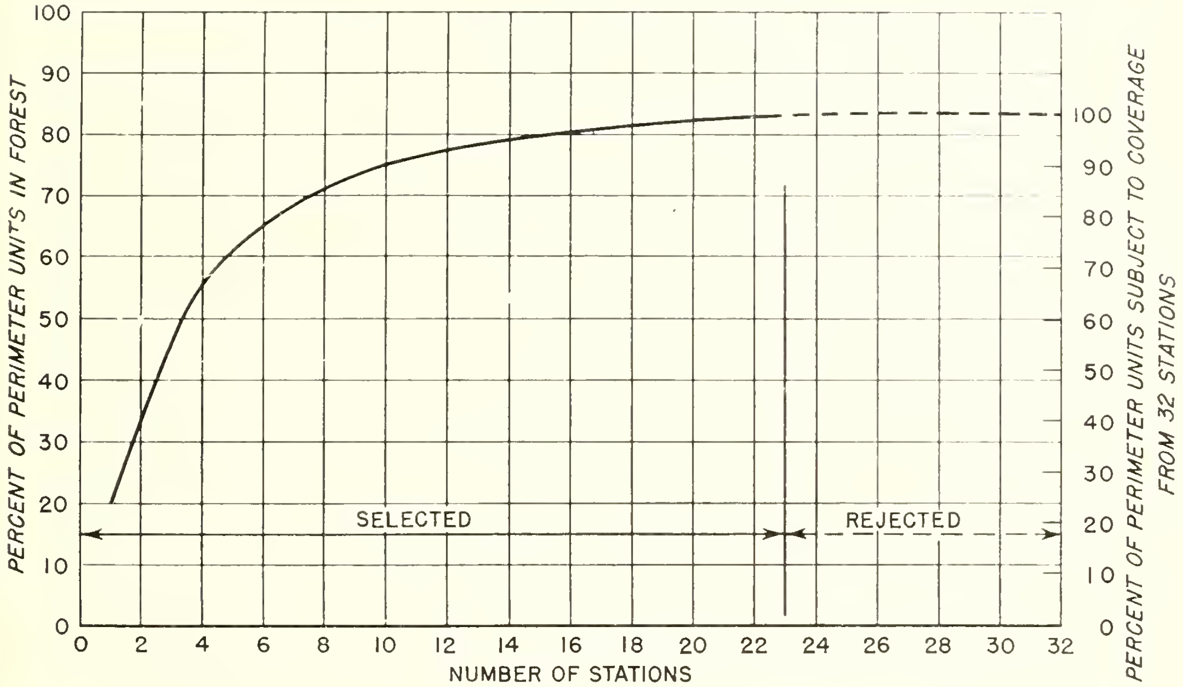
1. *Fire control stations—Travel time zones and fire occurrence map.*—This map shows by appropriate symbols the location and function of all planned fire control stations, the classification of the area to be protected as to travel time allowances and the location of occurrence of lightning fires from 1917 to 1936 and of man-caused fires from 1927 to 1936. For some forests the original travel time zone boundaries have been smoothed or generalized to eliminate small details, thereby reducing the amount of unnecessary detail work in completing this study.

2. *Initial attack and multiple coverage map.*—This map shows the theoretical limits of the areas within which each suppression unit could make the first attack on fires. It also shows by color legend the area that can be reached within allowable time limits from one, two, three, or more planned suppression stations. Areas that are reached within time limits from stations having only one man are cross-hatched.

3. *Existing road map.*—This map shows the locations, travel speeds, and distances between important points and road intersections for travel time in minutes between important points and road intersections. This map was prepared for the regional office files only.

VI. The following figure and tables are self-explanatory:

NET COVERAGE OF PERIMETER UNITS IN PERCENT OF TOTAL CUMULATING AS NUMBER OF STATIONS INCREASE



U S F S - W O - 1940

TABLE 1.—*Plumas National Forest—Suppression station locations studied*

Station Names	Location—Mount Diablo meridian			In detection plan	In transportation plan	In present suppression system	Remarks
	Section	Township	Range				
Almanor Dam	28	27 N.	8 E.	--------	--------	--------	
Bear Ranch Hill lookout-fireman.	13	23 N.	5 E.	x	--------	x	
Black Mountain lookout	8	26 N.	15 E.	x	--------	x	Used as a lookout fireman.
Boulder Creek guard station	15	27 N.	12 E.	--------	x	x	
Brush Creek ranger station	7	21 N.	6 E.	--------	x	x	
Bucks Lake guard station	3	23 N.	7 E.	--------	x	--------	
Cascade guard station	10	21 N.	7 E.	--------	x	x	
Challenge ranger station	20	19 N.	7 E.	--------	x	x	
Crocker guard station	33	24 N.	14 E.	--------	x	x	
Engel Mine	17	27 N.	11 E.	--------	--------	--------	
Fagan Saddle	36	23 N.	5 E.	--------	--------	--------	
Gansner Bar guard station	17	25 N.	7 E.	--------	x	x	
Geneseo	9	25 N.	11 E.	--------	--------	--------	
Greenville ranger station	3	26 N.	9 E.	--------	--------	x	
Jarbo Gap guard station	26	22 N.	4 E.	--------	--------	x	Lassen N. F. Station.
La Porte guard station	16	21 N.	9 E.	--------	x	x	
Laufman ranger station	1	26 N.	14 E.	--------	x	x	
Lights Creek guard station	33	28 N.	11 E.	--------	--------	x	
Meadow View guard station	8	25 N.	16 E.	--------	x	x	
Mohawk ranger station	9	22 N.	12 E.	--------	x	x	
Mooretown	14	20 N.	6 E.	--------	x	--------	
Portola	36	23 N.	13 E.	--------	--------	--------	
Prattville	11	27 N.	7 E.	--------	x	--------	
Pulga	31	23 N.	5 E.	--------	x	--------	
Quincy ranger station	14	24 N.	9 E.	--------	x	x	
Red Hill lookout-fireman	10	25 N.	7 E.	x	--------	--------	Used as primary lookout.
Red Rock lookout-fireman	11	28 N.	11 E.	x	--------	--------	
Spring Garden	31	24 N.	11 E.	--------	--------	--------	
Squaw Valley	3	25 N.	13 E.	--------	--------	--------	
Strawberry	29	20 N.	8 E.	--------	x	--------	
Taylorsville	34	26 N.	10 E.	--------	x	--------	

TABLE 2.—*Plumas National Forest—Tabulation of area fires and perimeter units*

Ranger districts	Zone I—½-hour travel time, 16.9 chains/hour							Zone II—1-hour travel time, 10.1 chains/hour						
	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.
	M acres	Percent	Number	Percent	Number	Percent		M acres	Percent	Number	Percent	Number	Percent	
Merimac	91.5	5.6	126.0	6.7	2,129	8.8	23.3	58.2	3.6	37.0	2.0	374	1.5	6.4
Quincy	79.9	4.9	245.0	13.1	4,140	17.1	51.8	89.7	5.5	76.0	4.1	768	3.2	8.6
Greenville	76.2	4.7	145.0	7.8	2,450	10.1	32.2	173.1	10.6	198.5	10.6	2,005	8.3	11.6
Milford	52.0	3.2	25.0	1.3	422	1.7	8.1	274.0	16.8	185.0	9.9	1,868	7.7	6.8
Beckwith	119.1	7.3	226.5	12.2	3,828	15.9	32.1	145.7	8.9	120.0	6.4	1,212	5.0	8.3
La Porte	108.2	6.6	176.5	9.5	2,983	12.4	27.6	134.6	8.3	104.0	5.6	1,050	4.4	7.8
Total	526.9	32.3	944.0	50.6	15,952	66.0	30.3	875.3	53.7	720.5	38.6	7,277	30.1	8.3

Ranger districts	Zone III—2-hour travel time, 6.5 chains/hour							Agricultural areas						
	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.
	M acres	Percent	Number	Percent	Number	Percent		M acres	Percent	Number	Percent	Number	Percent	
Merimac	34.2	2.1	23.0	1.2	150	0.6	4.4	------	------	------	------	------	------	------
Quincy	19.1	1.2	7.5	0.4	49	0.2	2.6	4.4	0.3	24.0	1.3	------	------	------
Greenville	27.4	1.7	31.0	1.7	202	0.8	7.4	12.7	0.8	17.0	0.9	------	------	------
Milford	23.5	1.4	14.5	0.8	94	0.4	4.0	1.7	0.1	1.0	0.1	------	------	------
Beckwith	43.0	2.6	26.5	1.4	172	0.7	4.0	2.1	0.1	14.0	0.7	------	------	------
La Porte	59.9	3.7	41.5	2.2	270	1.1	4.5	------	------	------	------	------	------	------
Total	207.1	12.7	144.0	7.7	937	3.8	4.5	20.9	1.3	56.0	.30	------	------	------

Ranger districts	All zones						
	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.
	M acres	Percent	Number	Percent	Number	Percent	
Merimac	184.0	11.3	186.0	10.0	2,653	11.0	14.4
Quincy	193.0	11.8	352.5	18.9	4,957	20.5	25.7
Greenville	289.4	17.8	391.5	21.0	4,657	19.3	16.1
Milford	351.2	21.5	225.5	12.1	2,384	9.8	6.8
Beckwith	309.9	19.0	387.0	20.7	5,212	21.6	16.8
La Porte	302.7	18.6	322.0	17.3	4,303	17.8	14.2
Total	1,630.2	100.0	1,864.5	100.0	24,166	100.0	14.8

TABLE 3.—*Plumas National Forest—Relative need for tank trucks by ranger districts*

Districts	Total perimeter units on district	Reachable by tanker		
		Perimeter units	Percent of district perimeter units	Percent of forest perimeter units
Merimac	2, 653	1, 346	51	10
Quincy	4, 957	3, 130	63	23
Greenville	4, 657	2, 691	58	19
Milford	2, 384	696	29	5
Beckwith	5, 212	3, 388	65	25
La Porte	4, 303	2, 466	57	18
Forest Total	24, 166	13, 717	57	100

TABLE 4.—*Plumas National Forest—Gross, contributed, and gross tanker values and conference decisions for all stations studied; and initial attack and unduplicated values for each station selected*

	Gross value perimeter units	Contributed value		Gross tanker value perimeter units	Undup. value perimeter units	Initial attack value			Conference decisions approved for—	
		Perimeter units	Cumulative percent			Perimeter units covered	Perimeter units not covered	Total perimeter units	Men	Tanker
1. Quincy ranger station	4, 650	4, 650	19. 2	3, 354	757	2, 626	439	3, 065	10	1 standard.
2. Portola	4, 300	3, 529	33. 8	3, 570	226	1, 399	323	1, 722	5	Do.
3. Greenville ranger station	4, 451	2, 972	46. 1	3, 284	223	2, 113	250	2, 363	5	Do.
4. Challenge ranger station	2, 475	2, 475	56. 4	1, 813	1, 124	1, 597	313	1, 910	10	Do.
5. Gansner Bar guard station.	3, 021	1, 101	60. 9	1, 920	866	1, 755	250	2, 005	5	Do.
6. Brush Creek ranger station.	961	934	64. 8	811	802	820	186	1, 006	5	Do.
7. Laufman ranger station	1, 043	853	68. 3	568	320	605	161	766	5	Do.
8. Strawberry	2, 029	643	71. 0	1, 648	311	1. 090	135	1, 225	3	Do.
9. Lights Creek guard station.	1, 463	629	73. 4	785	150	787	41	828	3	Do.
10. Genesee	2, 435	429	75. 4	1, 802	142	612	143	755	3	Do.
11. Bucks Lake guard station	743	282	76. 5	389	242	481	99	580	1	None.
12. Crocker guard station	2, 382	241	77. 5	1, 896	111	811	195	1, 006	5	1 standard.
13. Mohawk ranger station	3, 979	216	78. 4	3, 330	162	1, 789	180	1, 969	5	Do.
14. Fagan Saddle	507	195	79. 2	348	110	196	152	348	3	None.
15. La Porte guard station	1, 125	176	80. 0	640	116	606	180	786	3	Do.
16. Almanor Dam	2, 535	163	80. 6	2, 021	66	816	191	1, 007	5	1 standard.
17. Meadow View guard station.	398	162	81. 3	182	162	252	312	564	1	None.
18. Squaw Valley	976	110	81. 8	548	55	419	76	495	3	1 standard.
19. Spring Garden	3, 873	60	82. 0	3, 293	60	648	81	729	5	Do.
20. Mooretown	283	59	82. 3	243	34	64	169	233	5	Do.
21. Jarbo Gap guard station	453	51	82. 5	342	51	135	194	329	(1)	(1)
22. Cascade guard station	261	30	82.6	147	30	99	17	116	1	None.
23. Boulder Creek guard station.	1, 232	25	82. 7	592	20	265	94	359	1	Do.
Total	------	19, 985	82. 7	------	6, 140	19, 985	4, 181	24, 166	---	------------
24. Prattville	1, 614	61	83. 0	1, 304	------	------	------	------	Rejected.	
25. Taylorsville	3, 496	46	82. 1	2, 617	------	------	------	------	Do.	
26. Black Mt. lookout	529	5	83. 2	288	------	------	------	------	Primary lookout	
27. Bear Ranch Hill lookout-fireman.	267	0	------	182	------	------	------	------	Do.	
28. Pulga	522	0	------	[2] Low	------	------	------	------	Rejected.	
29. Engelmine	1, 783	0	------	[1] Mod.	------	------	------	------	Do.	
30. Red Rock lookout-fireman	[2] Low	0	------	[2] Low	------	------	------	------	Detection value.	
31. Red Hill lookout-fireman	[2] Low	0	------	[2] Low	------	------	------	------	Do.	
32. Three Lakes lookout-fireman.	[2] Low	0	------	[2] Low	------	------	------	------	Rejected.	

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[1] Lassen station.

[2] As these values were obviously so low, and the stations in question had no contributed value, it was not considered necessary to compute them.

TABLE 5.—*Plumas National Forest—Area by travel time zones covered within allowable time limits by 23 approved stations*

Zone No.	Total zone acreage, M acres	First 5 stations		First 10 stations		First 15 stations		23 stations	
		M acres	Percent in zone	M acres	Percent in zone	M acres	Percent in zone	M acres	Percent in zone
I	526.9	165.4	31	224.3	43	245.4	47	266.3	51
II	875.3	351.0	40	543.7	62	633.4	72	729.4	83
III	207.1	125.4	61	158.6	77	204.9	99	206.7	100
Total	1,609.3	641.8	40	926.6	58	1,083.7	67	1,202.4	75

TABLE 6.—*Fires by travel time zones covered within allowable time limits by 23 approved stations*

Zone No.	Total fire occurrence	Total fires covered	Percent covered by zones
I	944.0	774.0	82
II	720.5	594.5	83
III	144.0	144.0	100
Total	1,808.5	1,512.5	84

TABLE 7.—*Plumas National Forest—Gross station coverage of lightning and total perimeter units by ranger districts*

Ranger districts (station names)	Merrimac		Quincy		Greenville		Milford		Beckwith		La Porte		Total	
	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total
1. Quincy ranger station	34	140	446	3,314	136	583	---	---	110	558	42	55	768	4,650
2. Portola	---	---	56	213	---	---	90	130	579	3,936	7	21	732	4,300
3. Greenville ranger station	---	---	64	1,426	690	2,963	---	---	15	62	---	---	769	4,451
4. Challenge ranger station	---	---	---	---	---	---	---	---	---	---	168	2,475	168	2,475
5. Gansner Bar guard station	11	402	56	1,543	253	1,076	---	---	---	---	---	---	320	3,021
6. Brush Creek ranger station	62	961	---	---	---	---	---	---	---	---	---	---	62	961
7. Laufman ranger station	---	---	---	---	---	---	604	978	65	65	---	---	669	1,043
8. Strawberry	---	---	---	---	---	---	---	---	---	---	330	2,029	330	2,029
9. Lights creek guard station	---	---	15	75	596	1,287	81	101	---	---	---	---	692	1,463
10. Genesee	---	---	45	115	473	1,807	60	80	195	433	---	---	773	2,435
11. Bucks Lake guard station	119	502	76	241	---	---	---	---	---	---	---	---	195	743
12. Crocker guard station	---	---	6	66	20	27	302	402	471	1,873	7	14	806	2,382
13. Mohawk ranger station	---	---	90	520	---	---	20	40	478	3,372	19	47	607	3,979
14. Fagan Saddle	82	507	---	---	---	---	---	---	---	---	---	---	82	507
15. La Porte guard station	---	---	---	---	---	---	---	---	16	16	309	1,109	325	1,125
16. Almanor Dam	---	---	35	115	485	2,420	---	---	---	---	---	---	520	2,535
17. Meadow View guard station	---	---	---	---	---	---	311	398	---	---	---	---	311	398
18. Squaw Valley	---	---	---	---	10	10	442	643	163	323	---	---	615	976
19. Spring Garden	10	63	337	1,878	75	234	---	---	208	1,671	20	27	650	3,873
20. Mooretown	---	---	---	---	---	---	---	---	---	---	88	283	88	283
21. Jarbo Gap guard station	17	405	---	37	11	11	---	---	---	---	---	---	28	453
22. Cascade guard station	---	---	---	---	---	---	---	---	---	---	100	261	100	261
23. Boulder Creek guard station	---	---	---	---	328	632	376	527	26	73	---	---	730	1,232
24. Prattville	---	---	15	92	338	1,522	---	---	---	---	---	---	353	1,614
25. Taylorsville	---	---	50	351	789	2,854	18	38	112	253	---	---	969	3,496
26. Black Mountain lookout	---	---	---	---	---	---	373	484	45	45	---	---	418	529
27. Bear Ranch Hill lookout-fireman	63	267	---	---	---	---	---	---	---	---	---	---	63	267
28. Pulga	17	476	---	17	19	29	---	---	---	---	---	---	36	522
29. Engelmine	---	---	15	75	661	1,627	49	69	5	12	---	---	730	1,783
30. Red Rock lookout-fireman	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31. Red Hill lookout-fireman	---	---	---	---	---	---	---	---	---	---	---	---	---	---
32. Three Lakes lookout-fireman	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 8.—*Plumas National Forest—Contributed station coverage of lightning and total perimeter units by ranger districts*

Ranger districts (station names)	Merrimac		Quincy		Greenville		Milford		Beckwith		La Porte		Total	
	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total
1. Quincy ranger station	34	140	446	3,314	136	583	----	----	110	558	42	55	768	4,650
2. Portola	----	----	----	----	----	----	90	130	469	3,378	7	21	566	3,529
3. Greenville ranger station	----	----	5	547	554	2,380	----	----	15	45	----	----	574	2,972
4. Challenge ranger station	----	----	----	----	----	----	----	----	----	----	168	2,475	168	2.475
5. Gansner Bar guard station	11	402	16	550	37	149	----	----	----	----	----	----	64	101
6. Brush Cr. ranger station	55	934	----	----	----	----	----	----	----	----	----	----	55	934
7. Laufman ranger station	----	----	----	----	----	----	519	853	----	----	----	----	519	853
8. Strawberry	----	----	----	----	----	----	----	----	----	----	172	643	172	643
9. Lights Creek guard station	----	----	----	----	376	550	59	79	----	----	----	----	435	629
10. Genesee	----	----	----	----	82	167	45	55	113	207	----	----	240	429
11. Bucks Lake guard station	65	267	15	15	----	----	----	----	----	----	----	----	80	282
12. Crocker guard station	----	----	----	----	----	----	75	125	89	116	----	----	164	241
13. Mohawk ranger station	----	----	----	----	----	----	----	----	94	204	5	12	99	216
14. Fagan Saddle	8	195	----	----	----	----	----	----	----	----	----	----	8	195
15. La Porte guard station	----	----	----	----	----	----	----	----	----	----	65	176	65	176
16. Almanor Dam	----	----	----	----	61	163	----	----	----	----	----	----	61	163
17. Meadow View guard station	----	----	----	----	----	----	132	162	----	----	----	----	132	162
18. Squaw Valley	----	----	----	----	----	----	90	110	----	----	----	----	90	110
19. Spring Garden	----	----	13	13	----	----	----	----	13	47	----	----	26	60
20. Mooretown	----	----	----	----	----	----	----	----	----	----	15	59	15	59
21. Jarbo Gap guard station	----	51	----	----	----	----	----	----	----	----	----	----	----	51
22. Cascade guard station	----	----	----	----	----	----	----	----	----	----	10	30	10	30
23. Boulder Cr. guard station	----	----	----	----	5	5	20	20	----	----	----	----	25	25
Total	173	1,989	495	4,439	1,251	3,997	1,030	1,534	903	4,555	484	3,471	4,336	19,985
24. Prattville	----	----	----	----	----	61	----	----	----	----	----	----	----	61
25. Taylorsville	----	----	----	----	36	46	----	----	----	----	----	----	36	46
26. Black Mountain lookout	----	----	----	----	----	----	5	5	----	----	----	----	5	5
27. Bear Ranch H lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0
28. Pulga	----	----	----	----	----	----	----	----	----	----	----	----	----	0
29. Engelmine	----	----	----	----	----	----	----	----	----	----	----	----	----	0
30. Red Rock lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0
31. Red Hill lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0
32. Three Lakes lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0

TABLE 9.—*Plumas National Forest—Contributed values of the 23 approved stations, by districts*

Rank	Ranger District station names	Contributed value, perimeter units													
		Merimac		Quincy		Green-ville		Milford		Beckwith		La Porte		Total	
		Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on Forest
1	Quincy ranger station	140	5. 3	3, 314	66. 9	583	12. 5			558	10. 7	55	1. 3	4, 650	19. 2
2	Portola							130	5. 5	3, 378	75. 5	21	1. 8	3, 529	33. 8
3	Greenville ranger station			547	77. 9	2, 380	63. 6			45	76. 4			2, 972	46. 1
4	Challenge ranger station											2, 475	59. 3	2, 475	56. 4
5	Gansner Bar guard station	402	20. 4	550	89. 0	149	66. 8							1, 101	60. 9
6	Brush Creek ranger station	934	55. 6											934	64. 8
7	Laufman ranger station							853	41. 2					853	68. 3
8	Strawberry											643	74. 2	643	71. 0
9	Lights Creek guard station					550	78. 6	79	44. 5					629	73. 4
10	Genesee					167	82. 2	55	46. 9	207	80. 4			429	75. 4
11	Bucks Lake	267	65. 7	15	89. 3									282	76. 5
12	Crocker guard station							125	52. 1	116	82. 6			241	77. 5
13	Mohawk ranger station									204	86. 5	12	74. 5	216	78. 4
14	Fagan Saddle	195	73. 0											195	79. 2
15	La Porte guard station											176	78. 6	176	80. 0
16	Almanor Dam					163	85. 7							163	80. 6
17	Meadow View							162	58. 9					162	81. 3
18	Squaw Valley							110	63. 5					110	81. 8
19	Spring Garden			13	89. 6					47	87. 4			60	82. 0
20	Mooretown											59	80. 0	59	82. 3
21	Jarbo Gap guard station	51	75. 0											51	82. 5
22	Cascade guard station											30	80. 7	30	82. 6
23	Boulder Cr. guard station					5	85. 8	20	64. 3					25	82. 7
	Perimeter units covered	1, 989	75. 0	4, 439	89. 6	3, 997	85. 8	1, 534	64. 3	4, 555	87. 4	3, 471	80. 7	19, 985	82. 7
	Total perimeter units	2, 653	----	4, 957	----	4, 657	----	2, 384	----	5, 212	----	4, 303	----	24, 166	----

PROGRESSIVE STEP-UP ORGANIZATION

From the *Fireman's Guide,* just issued to members of the northern region of the U. S. Forest Service

Here is a method of organizing and managing men on line which borrows from the one-lick method, the 10- to 15-foot White Mountain variation of the one-lick method, and the individual assignment method which swept the Northern region at one time.

Thoughtful readers will perhaps wonder about the application of the method when the line needs to be driven ahead faster than 8 men could possibly push it. They may be dubious about the complexity of the system by which men are moved ahead. And they may be doubtful about the rigidity of the required organization of the 8-man crew. But one impartial observer reports that under certain circumstances he believes the method has the edge over the one-lick method.

We have then a fresh situation which invites attention from men of ingenuity—students of organization, fire specialists, forest supervisors, district rangers, and fire guards. Supervisor Huff of the Colville, who is said to have developed this particular method, may already have invented desirable improvements. But he has no monopoly on the method or the ingenuity required to build from it and the other ideas now in circulation on organization and management of men for fast construction of control line.

This system differs from the ordinary functional crew unit scheme in that the entire crew progresses forward with each member occupying the same position through the work period. The entire crew moves forward, each member maintaining a constant position in relation to the other workers.

The principle is that each member of a unit has a definite assignment of work to accomplish, and will work on this section until it is completed, or until some other member of the unit finishes, then the whole crew moves forward to new ground. The number of step-ups to be moved forward is the same as the number finished.

Ordinarily the following routine is followed:

The crew consists of 3 seven-man squads with a straw boss in charge of each. These three squads are exclusive of one or more saw crews which are stationed at the rear of the unit. The first squad, which follows the line locator, is composed of axmen whose sole duty is to clear the way for digging tools. Following the axmen is the grubhoe squad, whose duty it is to loosen the ground for the third squad of shovel men who shovel out down to mineral soil, leaving behind them a finished trench. Large logs and snags left by the ax crew are cut by the sawers. Each saw crew is composed of three men, one of whom has a shovel to dig out under logs and to complete trench after sawing.

To add flexibility to this foreman's unit, the last two or three men in the ax squad are equipped with pulaskis instead of axes. Then if the clearing work becomes heavy, the pulaski men of the hoe squad can assist the axes or, if the digging is slow and difficult, the pulaski men of the ax squad assist the hazel hoes.

The men progress with their line construction as follows:

Each squad, *before they start work building line*, space themselves a given distance apart (about 15 feet) along the ground where the line has been located. Individuals are assigned to a definite position within the squad, numbered 1, 2, 3, 4, 5, 6, and 7, and they remain in that relative position at all times. For illustration, assume we are dealing with the ax crew composed of 7 choppers and 1 straw boss in charge. The number 1 or leading man walks out the located line 90 feet and stops. The number 2 man walks out 75 feet, which places him 15 feet behind the leader, and so on with the entire 7 men. This leaves the seventh man standing at a point where line construction is to begin. A simple way to obtain the proper spacing is to instruct the squad boss to stand at the point of beginning and have the men file past him in order, 15 feet apart. When the last man is reached, he cries "Halt!" and the crew is then ready to start work.

It is the duty of each squad straw boss to supervise the work of his crew, and as this requires all of his time he uses no tool except in rare instances.

After the squad is lined out, they all begin work simultaneously at the command of the straw boss. Each man *completes* the work required of whatever tool he is using as he goes. For example, if he is an axman, he does all the clearing that has to be done as he advances, or if he is a hoeman he completes the loosening of the soil as he goes.

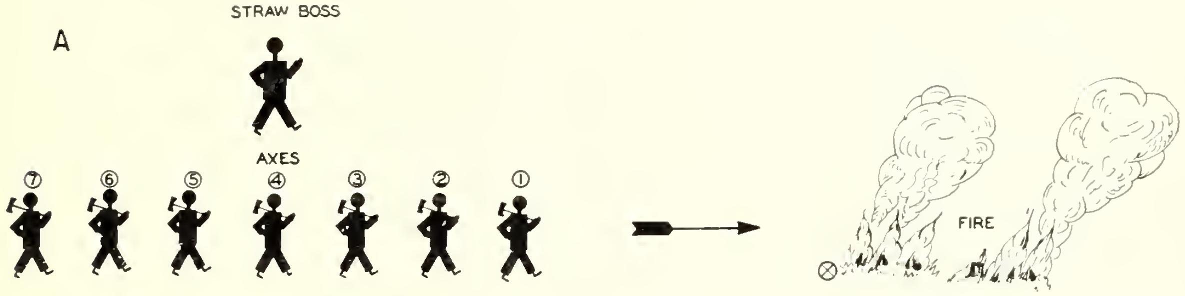
Because of variations in working conditions, even from one end of a squad to the other, it is always the case that one or more men reach the point where the man ahead of him started before the others, and thus he has nothing further to do unless he goes past the men ahead. In order to avoid this undesirable procedure, the straw boss, whose duty it is to observe when a man completes his portion of line, makes a loud verbal command such as "Four" (pause), "up one," or "Smith" (pause), "up one." This command implies to the squad that Smith, who is number 4 man in the squad, has completed his section of line and that all workers in front of and including Smith must move up to the point where the man ahead was working, while number 1 steps forward 15 feet.

If two men finish at the same time—for example, numbers 4 and 5—the straw boss indicates the name and number of the one *closest to the rear of the squad* (in this case number 5) and orders up *two*, thus: "Five" (pause), "up two." This order implies to the squad that all the workers in front of and including number 5, move up two spaces, while number 1 goes out 30 feet and number 2 out 15 feet beyond the point where number 1 was working prior to the order. The reason only those from the finishing worker forward move up at an order is that, if the entire squad advanced there would be no one with that type of tool to complete the space left by the last man after he changed position.

Under this system it is obvious that the straw boss is the key to a smooth working squad, and it is extremely necessary that he be alert at all times. Also it is essential that the leading or first man in each squad know how to pace or be able to judge distances as it is he who controls the spacing of men. The foregoing description of squad control applies to all squads regardless of tools, except the saw crews, which, because of their type of work, together with the fact they are last in the foreman's unit, merely progress as the logs, etc., are removed by them. One set of sawers often requires no straw boss, but when two or more are used the need for a boss to line out the work is evident.

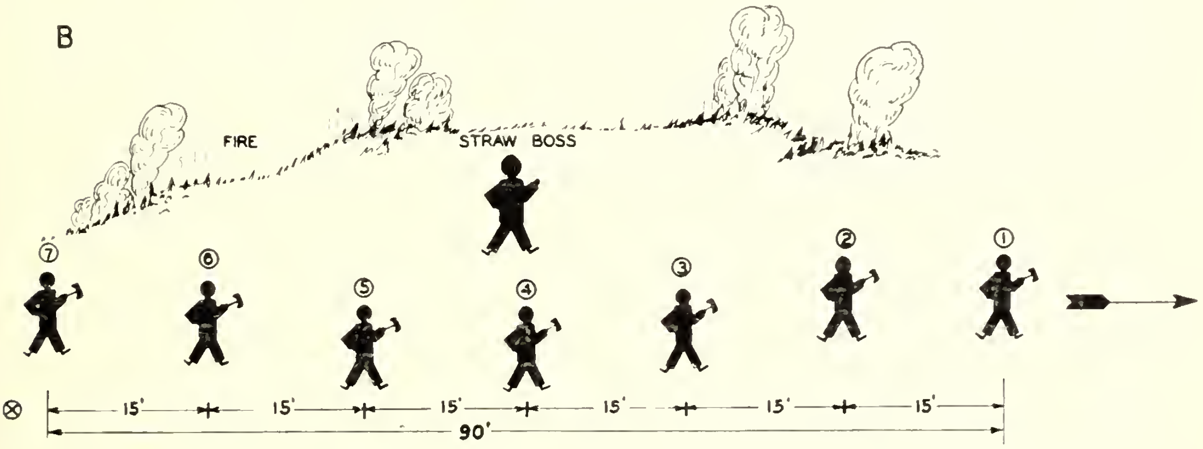
The foreman, in addition to directing the attack and assuming responsibility for his portions of the fire, controls the functioning of his unit through each squad straw boss.

The following diagrams and descriptions portray the functioning of the organization on the ground at a fire, from the moment the men are ready to be lined out.



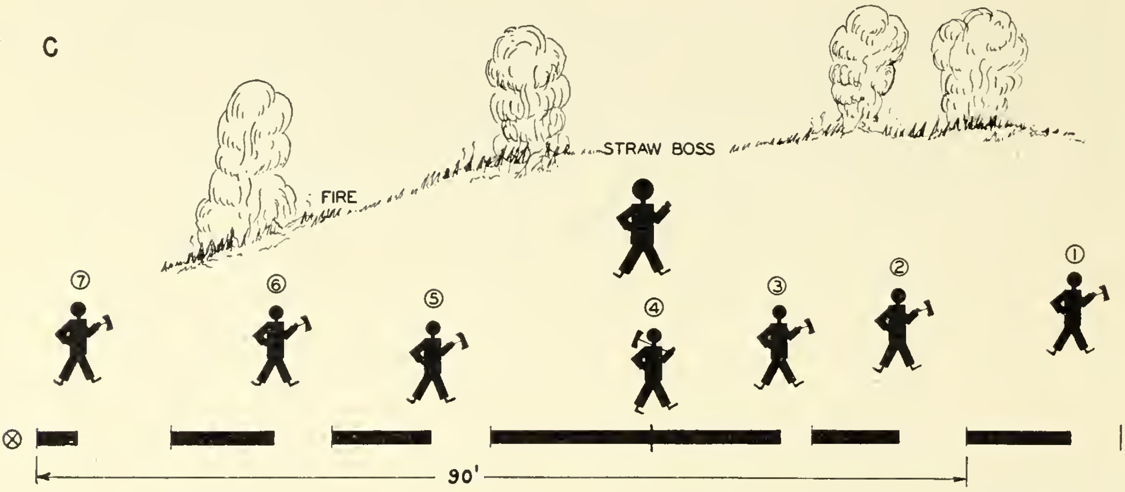
In illustration A the point where line construction is to begin is represented by the letter "X." The figures in circles represent the men grouped in close file in their relative positions within any squad at "X." Number 1 is the lead-off man and number 7 is the last tool-equipped man in an 8-man squad. The straw boss is the eighth man of the squad. The arrow indicates the direction in which line is to be built.

The straw boss allows the men with their tools to file past "X," holding each individual in turn at that point until the man ahead has moved out 15 feet. Number 1 steps out first, followed by 2, then 3 until number 6 is reached. When 6 has advanced 15 feet, the straw boss shouts "Halt!" This leaves number 7 at "X;" number 6, 15 feet out; number 5, 30 feet out; and so on to number 1 who is 90 feet from "X." See illustration B.

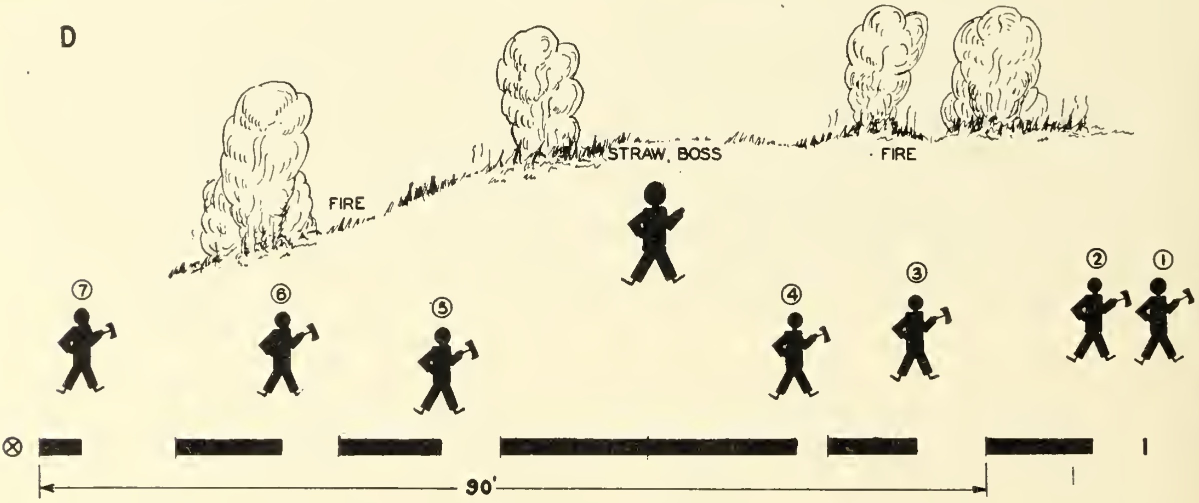


Following the above procedure, the straw boss gives the command to start work. Each man works always toward the man ahead, i. e., 7 toward 6, 6 toward 5, etc. Also, as he advances in this manner, he completes as he goes *all* the work required of whatever tool he is using.

After a short interval of time, some one man within the squad reaches a point where the man preceding him started work. The relative positions of the men, showing work accomplished up to that moment, is given in illustration C.

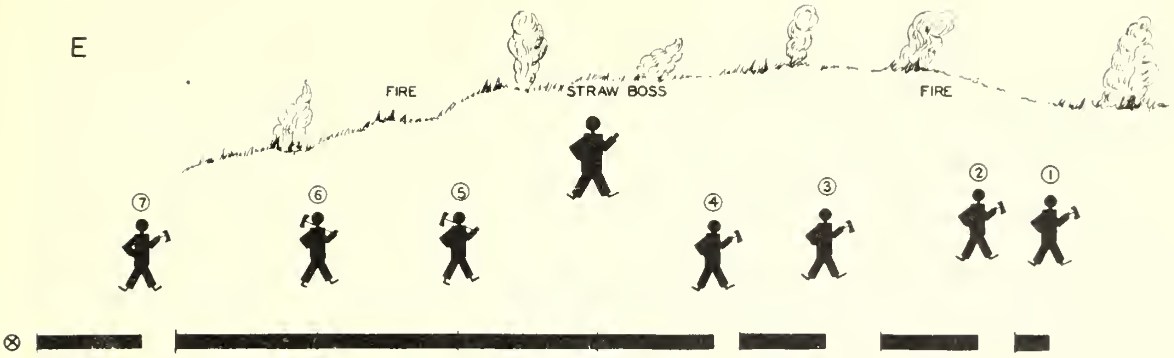


The perpendicular line represents where each man started working. The solid line represents work accomplished up to the moment number 4 reached the point where number 3 started. As 4 reaches 3's starting point, the straw boss shouts "Four" (pause), "up on," indicating that everyone from 4 through 1 move up to the spot where the man ahead is working. Number 1 moves forward 15 feet. Numbers 5, 6, and 7 do not move but continue working where they are. The result is diagrammed in illustration D.

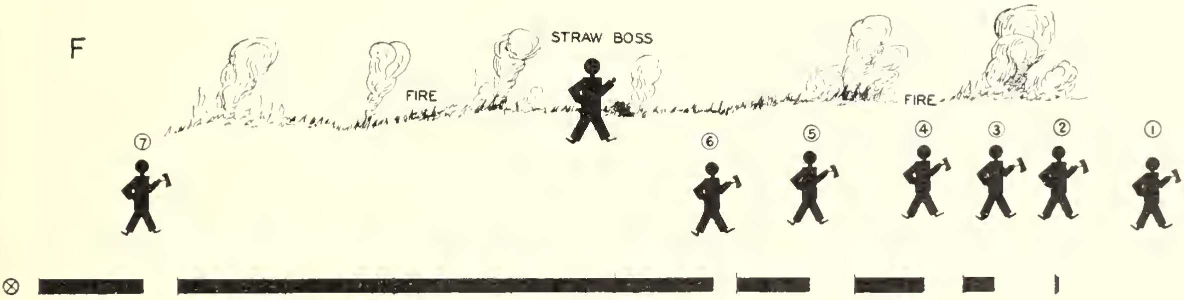


As the men continue working let us assume that numbers 5 and 6 reach simultaneously the point where the men ahead of them started. The positions at that moment are indicated in illustration E.

The straw boss then orders "Six, up two." Number 1 moves out 30 feet. Number 2 moves out 15 feet beyond the point where 1 was working prior to the order, which places him 15 feet behind the new position of number 1. Number 3 moves into the space behind 2, which is the spot where 1 was working, and so on down to 6. Number 7 does not move up. The new positions are indicated in illustration F.



At any time the order is "up two" or more than two, it is best that number 1 be allowed to place himself in his new position first. Then 2 places himself behind 1; 3 behind 2, and so on in order. In this way it is necessary for only the leading man to estimate the distance to his new position as everyone following in turn, places himself in the space immediately behind the man ahead.



It should be understood that whenever number 7 reaches the point where 6 started, the order "Seven, up one" applies to the entire squad and everyone advances one space.

The foregoing descriptions and diagrams of positions are applicable to all squads regardless of tools used except the saw unit.

Application of good judgment by the straw boss in issuing orders, and accurate estimation of distances and knowledge of pacing on the part of the number 1 man in each squad, cannot be overemphasized if maximum efficiency is to be gained from this method. Numerous demonstrations by trained CCC crews and calculations of trench constructed per man-hour under all conditions, have proved definitely the "progressive step method" is noticeably superior to many older methods. Not only is speedier work accomplished, but also a finished trench is assured when the last man passes any point, and in addition the output of each individual is evident at all times. There is no opportunity for "soldiering" on the job.

From the standpoint of safety, the method has further advantages. Workers are not passing one another while carrying sharp tools. They are never so close together there is danger of one striking the other, and, third, in compliance with our safety regulations, each man has opportunity to assume the proper stance while using his tools.

THE AUSTIN ROTARY ORGANIZATION (FOR GRASS FIRES)

This method was described under the title of the "Spinning Fireman Method for Grass Fires" in the July 1940 issue of Fire Control Notes. The following description of the same method is from the Northern region's instructions to men of that organization, and is reproduced here because it is much clearer than the previous description.

Because the scheme will not work where mineral soil is not readily available, the reader's mind may turn to the possibility of supplying loose dirt or sand to the shovel men from a truck driven alongside the rotating members of the crew. Various ways come to mind of applying dirt from a truck to the fire edge by means of a machine such as those used for sanding icy roads. But would a mechanism and crew for putting dirt on a fire in this way be as efficient as a tank truck using water for the same purpose? That is the point where the next stage of experimentation and creative thinking should take over.

Just after the above was written, a letter came from a company producing finely ground diatomacious earth which the company claims is "death on fire." Any mineral earth dust is of course "death on fire" to some degree. Whether diatomacious earth dust would have any net value over ordinary dirt or dust is doubtful, but may be worth looking into. The Northern region has been requested to do so.

This scheme for handling men on the line was developed to speed up suppression of fast-spreading fires in light grass fuels. It is a progressive method and eliminates any lost motion if properly managed. It has proved very effective for small crews on cheat grass fires.

Normally, not more than five men are used. Four is an adequate number where digging is not too difficult. The scheme will not work where mineral soil is not available, since the whole procedure reduces down to "knocking the fire out with dirt."

When the edge of the fire is reached and an anchor spot is found, the procedure is as follows:

Assuming one four-man crew, each equipped with a shovel and canteen of drinking water.

The first man fills his shovel, steps close to fire edge and whips the load of dirt as hard and as far as possible up the fire edge, one-half the dirt striking inside fire and one-half outside. He throws his dirt while moving forward; does not stop but moves ahead parallel to fire about three times the distance his shovel of dirt covered. (Each shovelful, if properly whipped, will knock out fire to 10 feet, depending on density of grass.) He moves one or two steps away from fire and begins loading his shovel again.

Man number 2 steps to fire edge at point where number 1's dirt swath ended, whips his shovelful and moves quickly ahead to a position beyond man number 1.

Number 3, following number 2, releases his shovelful of dirt and follows the action of number 1 and number 2. They have knocked the fire down to a point opposite number 1, and he immediately begins the procedure all over again. This is repeated time after time, each man maintaining his constant position in the crew.

Number four follows behind at all times, shoveling in smoldering chunks of wood, dung, roots, etc., and extinguishes those persistent tufts of matted grass which were not completely knocked out.

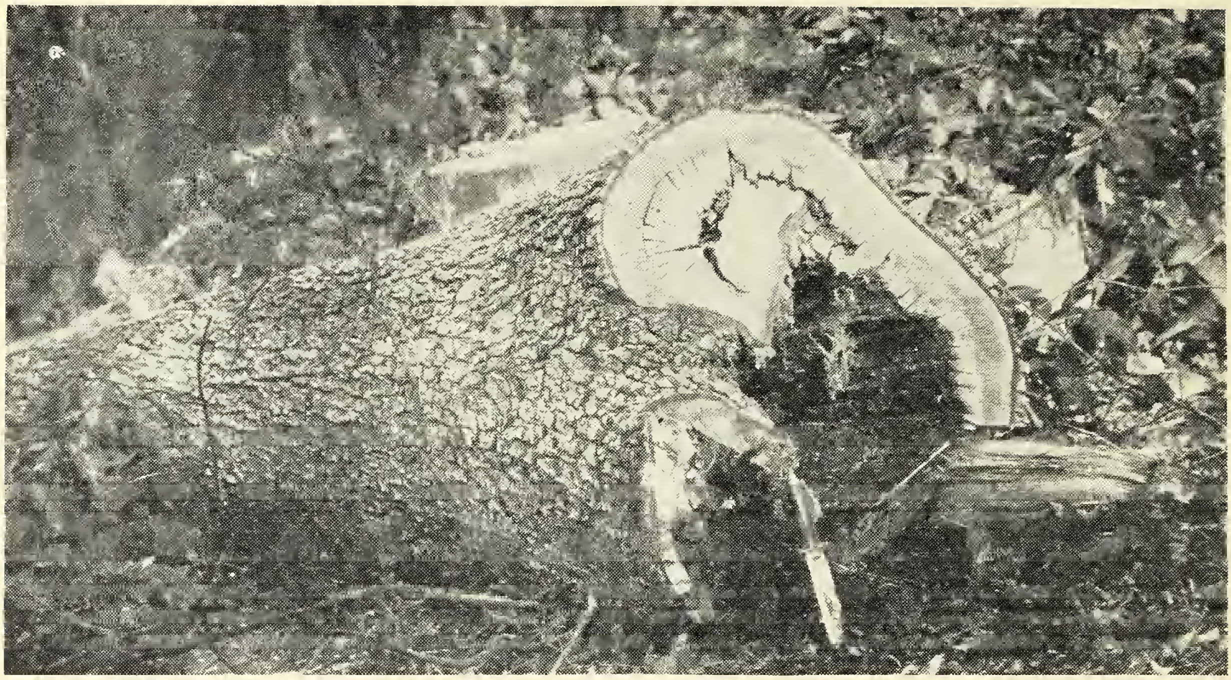
This movement gives the appearance of a three-man wheel rolling up the edge of the fire. Where dirt is plentiful, a four-man crew moves forward about as fast as the men would ordinarily walk.

SUMMARY OF FIRE PREVENTION PROBLEMS AND STATUS OF KNOWLEDGE

From an unpublished analysis of fire problems in the territory of the *Appalachian Forest Experiment Station* by George M. Jemison

Phase	Status of knowledge	Agencies working on problem	Action needed	Priority rating
Who starts fires	Good	U. S. Forest Service Administration, State foresters.	Continue as at present	
Where are problem areas	do	do	do	
When do fires occur	do	do	do	
Why are fires started—underlying causes of occurrence.	Meager	U. S. Forest Service Administration.	Expanded research by Appalachian Forest Experiment Station.	1
Determination of intangible fire effects.	do	U. S. Forest Service Administration, U. S. Biological Survey, privately endowed research in game management—Stoddard.	Expanded research by Appalachian Forest Experiment Station, U. S. Biological Survey, universities.	2
Determination of tangible fire effects on mortality, cull and growth.	Fair	Appalachian Forest Experiment Station.	Continued research by Appalachian Forest Experiment Station.	3
Development of damage appraisal methods for tangible values.	do	do	do	4
Development of damage appraisal methods for intangibles.	Meager	U. S. Forest Service Administration, State foresters.	Expanded research by Appalachian Forest Experiment Station, National Park Service, game specialists.	5
Development of effective methods of applying prevention methods and evaluation of accomplishments.	do	U. S. Forest Service Administration.	Expanded research by Appalachian Forest Experiment Station.	6

Cut-over, burned-over spruce type in North Carolina. The evaluation of such an effect of fire on site is a major problem that the Appalachian Forest Experiment Station has not yet undertaken. From an unpublished analysis of fire problems in the territory of the Appalachian Forest Experiment Station by George M. Jemison.



A valuable butt log culled because of decay that entered through a fire wound. Inasmuch as the decaying process takes place over many years and because the tree heals over the fire scar as shown above, determination of probable future cull due to fire is difficult. The Appalachian Forest Experiment Station is working on this problem. From an unfinished analysis of fire problems in the territory of the Appalachian Forest Experiment Station by George M. Jemison.

Economics of Fire Control.—The economics of fire control is really not a separate problem, but one which is tied in with every phase of the fire-control job and is so important that it deserves more than passing attention. Economic considerations enter into fire-control plans of all kinds; the determination of detection network, manpower requirements, and road and trail needs. If fire control is planned for on a sound business basis, then an economic objective must be set up. It resolves itself into a cost-accounting study (in the broadest sense), a job of finding the most profitable expenditure. As such it involves every phase of fire protection, particularly presuppression. This will constitute a major job for research in the future.—From an unpublished analysis of fire problems in the territory of the *Appalachian Forest Experiment Station* by George M. Jemison.

A Presuppression Theory.—Some of the best chances for saving fire-control dollars lie in making better and more efficient use of available presuppression facilities. If a fire protectionist were clairsentient and a sage as well, he would always be able to have exactly the right number of men at every spot a fire was going to occur. Presuppression and suppression costs would thus be reduced to an absolute minimum. Lacking such powers, the official responsible for fire control can do one of three things: (1) have a man "behind every tree," (2) have no men until a fire starts, or (3) attempt to strike a happy medium between the first two possibilities. The first would obviously be too expensive. The second would undoubtedly result in huge burned acreage because of lack of preparedness. Efficiency of fire control can be measured by the degree of success with which an administrator chooses the point of diminishing returns represented in the third possibility—the point where further expenditures fail to eliminate an equal amount of damage. The degree of presuppression effort should be aimed at this point of diminishing returns.—From an unpublished analysis of fire problems in the territory of the *Appalachian Forest Experiment Station* by George M. Jemison.

WINGS AND PARACHUTES OVER THE NATIONAL FORESTS

Roy Headley, *Fire Control, Washington, D. C.*

After the first World War, airplanes naturally drew the interest of forest officers. The California region did more than speculate about the possibilities. The only way which occurred to anyone to use these fascinating new machines was in systematic patrol for detection of fires. This was started in 1919 through the fine cooperation of the Army Air Corps. This cooperation incidentally led to enduring friendship between Forest Service men and Colonel Arnold, now General Arnold, and other members of the Army Air Corps who flew the "flying coffins" of that time and struggled with their temperamental engines. Some of the pilots of that day won fame later on for round-the-world flights and other contributions to human conquest of the air.

For several years, despite the accumulating evidence that airplanes could not compete with lookout men for first reports on fires, this attempt at aerial detection was continued. Then came a period in which the use of aircraft was confined to special detection flights after lightning storms and the scouting of going fires. Such special detection flights never discovered as many fires before they became visible to lookouts as was hoped, but the method has some real value and is a permanent thing. Aerial detection always was and always will be worth while when systematic stationary lookout service is not in effect. The very latest development along this line is on the Clark National Forest where smoke from widespread incendiary fires sometimes cripples the lookout system. When that happens the only alternative is detection by foot and motor patrolmen. But local businessmen own and love to fly the light and economical "cub" planes. One of them can be hired and kept pretty continuously in the air over a ranger district at a cost little, if any, higher than the cost of a corps of foot and motor patrolmen. When the smoke blanket is not too thick, fires can be seen from the air when the horizontal range from the ground would be very poor indeed. The low initial and operating costs of such planes make possible the continuity of detection, lack of which is the great defect of conventional aerial detection.

Scouting of large fires has also been continued and has lately been given a more practical turn by new techniques. Aerial pictures are developed while the plane circles for a short time and are dropped from the plane to the fire boss on the ground.

During the last 10 years, aircraft found its major field of usefulness in the transportation of materials, equipment, and supplies to be dropped where needed in remote locations or landed at one of the 80 fields which have been constructed on the national forests. In 1930 the author happened to be present at what was probably the start of the dropping of supplies. Howard Flint in Spokane received an urgent request from a fire at the head of the St. Joe River for aerial delivery of badly needed gasoline and oil for pumpers. With such ingenuity as he could command on short notice Howard packaged the gasoline and oil, and they were delivered with surprisingly little loss. Later the Northern region developed the tight-package method of dropping most types of supplies. This was superseded first by the loose-package method and then by the burlap parachute originally developed by Lage Wernstedt in the North Pacific region. The Northern region prefers condemned Army silk parachutes, when they can get them in sufficient quantity. This form of transportation to the more remote locations has proved so successful that for several years more than 100 tons of supplies have been delivered annually by that means to going fires.

Parachuting of men to fires was, therefore, a logical growth. T. V. Pearson of the Intermountain Region originally advocated the method in 1935 and succeeded in getting some experimental work done, but could make no permanent converts to his theory. In 1939, Harold King, the Forest Service engineer-pilot, and the hard-headed fire-control men of the North Pacific region took up the idea and swept all obstacles and opposition aside. By good luck and good management a manufacturer of a new steerable type of parachute was interested. In November 1939, 58 jumps were made on the Chelan National Forest to test the technical practicability of the method. By this time, the Russians were jumping men to fires, but apparently not in the sort of unfavorable terrain characteristic of our mountain forests with their abundance of snags and windfalls. So far as known, the Chelan project was the first to test premeditated parachute jumps in timbered mountain country. It was surprisingly successful. Landings were deliberately made in thick timber to get experience with what would happen if a jumper failed to hit an opening at which he had aimed. There is no profit in landing in a tree because that slows up the jumper on his way to the fire, and much labor is likely to be involved in getting the parachute down out of the tree. But successful parachuting must not depend on being able to miss the trees every time. It was found that landing in trees represented little hazard to either men or parachutes. The jumpers came to call them "feather-bed landings."

Before the end of the November experiment, much redesigning had been done on the harness, the protective suit, and the rope and other devices by which the parachute man lets himself down if he lands in a tree. Even the manufacturers' prize parachute had been changed slightly to make it open differently and give the man a less severe yank when the 30-foot chute opened with a loud report.

Another surprise was the success men had in landing close to or even on a mark. The long continued and expensive project for finding ways by which chemical solutions could be dropped on small fires had just been closed up as a good idea which would not work, because the required marksmanship from level flight in conventional planes simply could not be attained. But it developed that with the aid of the steering "flaps" on this parachute a man could come within a few yards of landing where he wanted to.

During the winter the experimental project was recorded in a careful report, as explained by Mr. Godwin in the April 1940 issue of Fire Control Notes.

By the end of June 1940, 16 more parachutes and accompanying outfits had been purchased and 16 volunteers trained for the next stage of the experiment. Eight men were to work from the Chelan National Forest in Washington, and eight from Missoula, Mont. Parachuting men to fires may be technically practicable still not profitable in the management of fire control. Most of the annual 4,000 fires in the Northern and North Pacific regions are easily extinguished by the nearest lookout firemen who go directly to them from the lookout stations which they must occupy anyway for fire detection purposes. Other fires spread almost immediately to such size that nothing less than hundreds of men would have a chance to stop them. Probably not over 200 fires out of the annual 4,000 offer any chance to obtain any net efficiency by the use of parachute firemen over other forms of transportation. Worst of all, these 200 fires do not automatically identify themselves as needing parachutists. The dispatcher in each case must judge—and guess. He may decide that fires Nos. 101, 102, and 103 need parachute firemen, only to discover when it is too late that these were easy fires, and that he should have sent his high speed parachute men to fires Nos. 104, 105, and 106. Or he may have 100 lightning fires occurring within a few hours, to each of which he would like to send all of his available parachute men. He may dispatch 20 parachute men to reinforce some hard-pressed crew in a losing battle, only to find later that just as the parachaute men arrived the wind went down and the men were not needed, or, on the other hand, that the fire went on into a big run despite the parachute reinforcements.

The management problem is, then, whether with fires occurring in unpredictable time and location patterns enough actual total reduction can be made in fire damage and costs of firefighting to cover the cost of this special form of transporting men to fires. The answer can only be found by actual tests—the first of which has been made during the past summer. If this initial test is favorable to parachuting of firemen and if the necessary funds can be had, the venture will be tried on a larger scale in 1941.

During the 22 seasons since aircraft was first used on the national forests, there has been a pretty large amount of aerial work done for detection, scouting, transportation of men and supplies, and photographic mapping. Survey of 133,742 square miles has been made by aerial photography, and these pictures have been converted into maps for 84,819 square miles. One rapidly growing use of airplanes is for quick mobilization of picked fireguards or, more often, Forest officer overhead on exceptionally difficult fires. Up to 150 men are now assembled at landing fields all over a region and flown to the landing field nearest a big fire with amazing speed. The imperative demands for trained overhead on a large fire can seldom be met adequately in any other way.

Although any flying over rugged mountain terrain is relatively dangerous, and both scouting and aerial delivery of supplies are particularly so, not one employee of the Forest Service has been killed in 22 seasons of flying—up to the time this issue clears from the Division of Fire Control on July 20. Considering the low elevation at which much of this flying must be done to be worth while, and the miles flown through dense smoke and among the deadly down drafts which occur around fires and in rough topography, this must be something of a record. It tells things about the skill and experience of mountain pilots and also about what forest officers have done in refusing to charter ships unless skilled mountain fliers are to pilot them.

Although no Forest Service employees have been killed, there have been fatalities, crashes, close calls, and injuries. In 1921, an Army Air Corps pilot was killed in taking off from the field at Alturas, Calif. Pilot Duck of California was killed in 1939 in Utah while flying west with a new cargo ship he had just purchased for use under a Forest Service contract. But he was not actually on a Forest Service job at the time. The only other fatality seems to be that of July 1940 when pilot Robert Maricich was killed while flying supplies to a Bitterroot National Forest fire in a plane owned by the Johnson Flying Service of Missoula, Mont. Del Claybaugh, a dropper employed by the Forest Service, was injured, but not fatally. At the date this is written, the crash is attributed to a down draft. A near-by lookout man was first to arrive at the scene of the crash, but the second was one of the new parachute firemen dropped for the rescue job and to report back by means of his new 6-pound radiophone.

The crashes and close calls known to the writer are these:

On the Bitterroot in 1939, when pilot Dick Johnson and Assistant Supervisor Sutliff crashed in a down draft in Goatrock country while looking for a camp site at which to deliver supplies. Although the plane was completely wrecked, both men escaped miraculously with only minor injuries. This was one of the three planes which the Johnson Flying Service has lost on Forest Service work within 2 years.

On the Flathead in 1938 when pilot Dick Johnson crashed when landing with a 2-ton load of improvement construction materials at Big Prairie landing field. This is understood to be another case of down draft.

On the Trinity in 1938 when a plane crashed in thick timber while dropping supplies to a fire, but without injuring either pilot or dropper.

On the Idaho some 10 years ago when a plane crashed after delivering men to a Forest Service landing field.

On the St. Joe some 10 years ago while Howard Flint and Pilot Nick Mamer were on an observation trip in a new plane. The engine quit cold. Although both men were equipped with parachutes, they took a look at the snags and rough ground under them and decided to ride the ship down. Both men were knocked out by the crash, but both came to and were able to walk out without aid.

In California in the early twenties when C. E. Rachford was in two crashes of the "flying coffins." In one instance a service man had failed to fill the radiator, and in the other the engine quit as engines of that time were prone to do. No one was hurt.

There have doubtless been other crashes, and it would be well if readers will report them for this permanent record, together with any corrections in the foregoing. Otherwise the information will soon begin to be inaccessible.

Even with all the accidents completely listed for the 22 years, the safety record will doubtless be a remarkable one considering the inescapable hazards. If we can only keep it up!

FIRE SUPPRESSION

By Robert Munro, *Forester, Southwestern Region, U. S. Forest Service.*

If you look through the index for Fire Control Notes and the tables of contents for issues since October 1939, you will find backfiring mentioned only twice—two articles on backfiring equipment by Fred Funke. It cannot be that backfiring is not an important tool. Some fires and some lives have been lost because of unskilled use of this tool. Many fires have been lost because of failures to use it at all. It cannot be that new ideas and skills are not needed. The subject is full of unsolved problems, the need for more skill, and good chances to develop new and better methods. When an observer succeeds in finding backfiring being done he too often has to groan inwardly over the awkwardness displayed. Backfiring is no longer taboo in regional handbooks. Some of them say "Use it—with skill and discretion, of course, but use it—or else." But until now, fresh ideas on backfiring have not appeared in Fire Control Notes. Perhaps the initiative of this author will break the spell that has hung over the subject. There is room to disagree with some of his statements, but the fact remains that out of his experience and for his particular conditions he has distilled some original ideas. Have any others learned something about backfiring in recent years?

In handling fire line work in the ponderosa pine type, which is the hazard zone in Region 3, a change is suggested from the old methed, i. e., line location, line constructions, backfiring, mop-up, and patrol. This proposed change would give the following order: line location, line construction, line mop-up, backfiring, and patrol. Fire spreads rapidly in the ponderosa pine type, but usually the fuels are light and may be handled fast. Consequently, the reason for this suggested change is that standing and down dead timber can be handled faster and with a greater degree of safety by locating the line so that line mopping up may be done before the backfiring is started. A substantial saving is also made in shortening the patrol time on the line, which in turn allows interior mop-up to start earlier. The mopped-up strip along the fire line will cool down quickly after it is burned over by the backfire if the dead timber is not there to hold fire. Danger of spot fires is also materially reduced. The lack of proper mop-up work has been a weak point in fire suppression work and has proved to be one of the causes of extra period fires.

This method hinges on the time factor and on proper line location, that is, if time and men are available to handle the job before the main fire strikes the line, the dead material can be handled much easier and faster when it is cool than when the crew is hampered by fire and smoke. The fire's behavior thus influences the line location, as the mop-up work is one of the main factors that must be considered in fire suppression work.

Except in emergencies, when it is necessary to do the work immediately, the backfiring should be done at night. There is usually less wind, and spot fires are more easily located. In handling the backfire job careful attention should be given to training the crew that will be used in this work, also to the training of the patrol crew and the crew used to control spot fires. Backfiring can be safely and effectively used if it is properly done.

The handling of this job during the day when wind velocity is usually highest is considered in these problems, as most failures occur under such conditions. Emergency conditions quickly develop when prompt action must be taken or the main line will be lost.

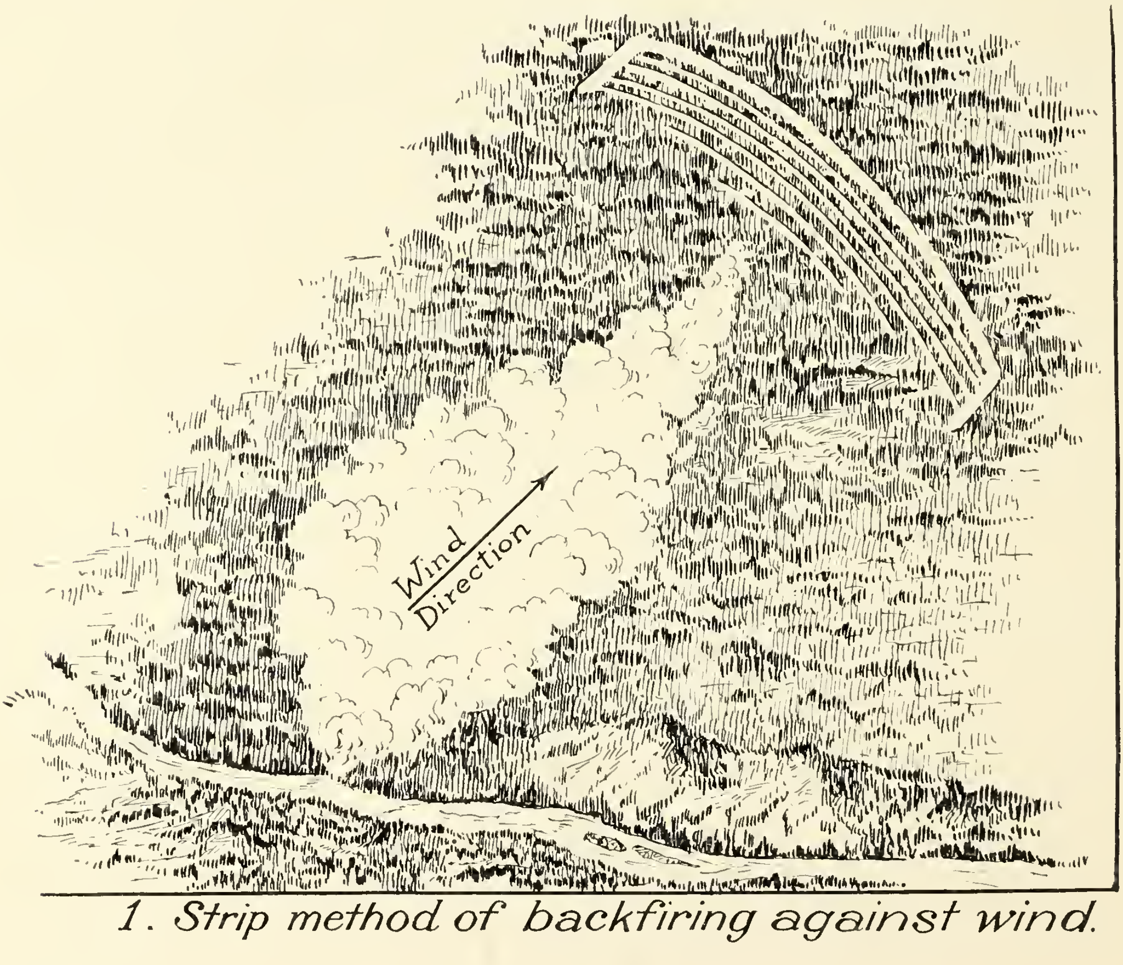
The problems presented therefore deal with emergency conditions that are common during peak periods.

It is important that the backfiring crew should be supervised by an experienced forest officer, who should also be directly responsible for the patrol and spot fire crews until the line has cooled down to the extent that it is safe to turn this work over to a patrol force.

The backfiring should always start at the highest point on the line and be worked downhill, by sections, giving due consideration to wind direction. The length of the sections should be governed by the amount of line that the crew can safely handle and patrol before the next section is backfired. Too much emphasis cannot be placed on the necessity for a vigilant patrol for spot fires until the line has cooled down to the extent that there is no further danger.

Problem 1

If the main fire is advancing before a strong wind a careful watch should be maintained for the development of a fast running point



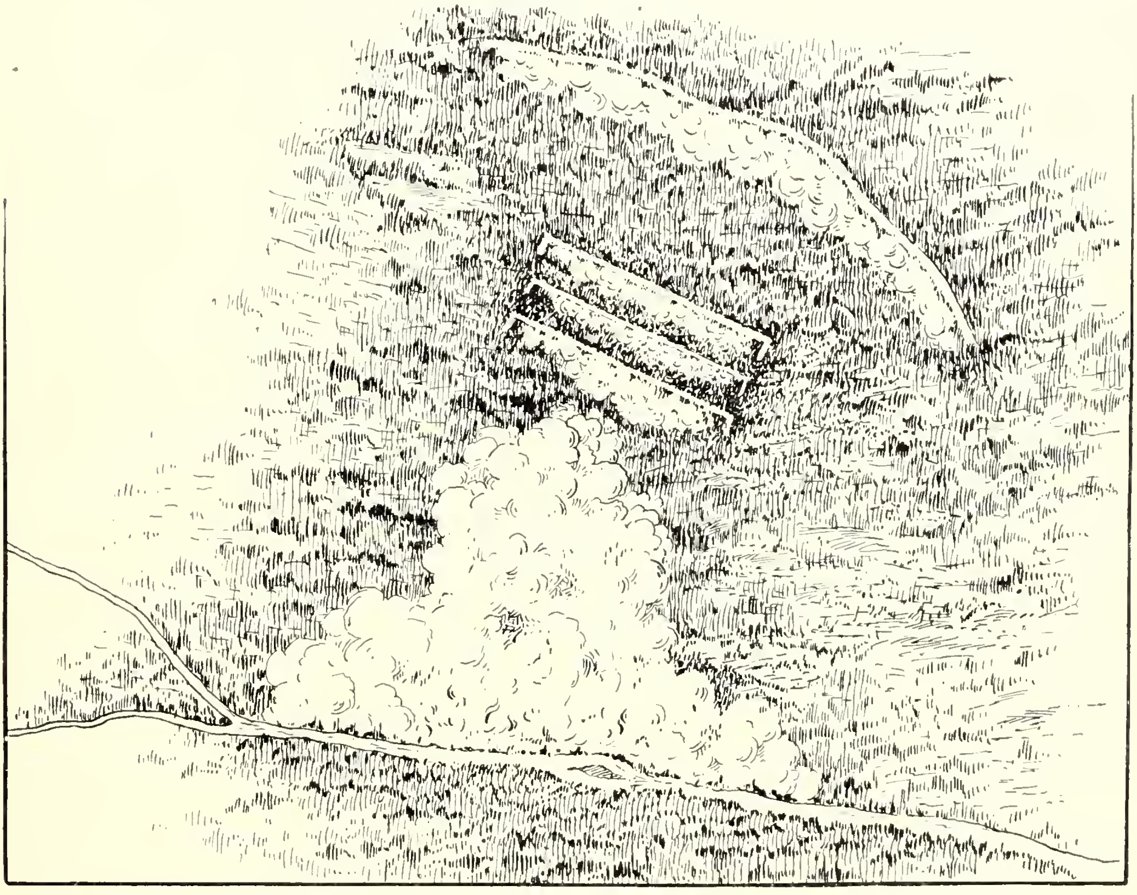
1. Strip method of backfiring against wind.

that may strike the fire line before the backfire has burned back far enough to eliminate the danger of the main fire jumping the fire line.

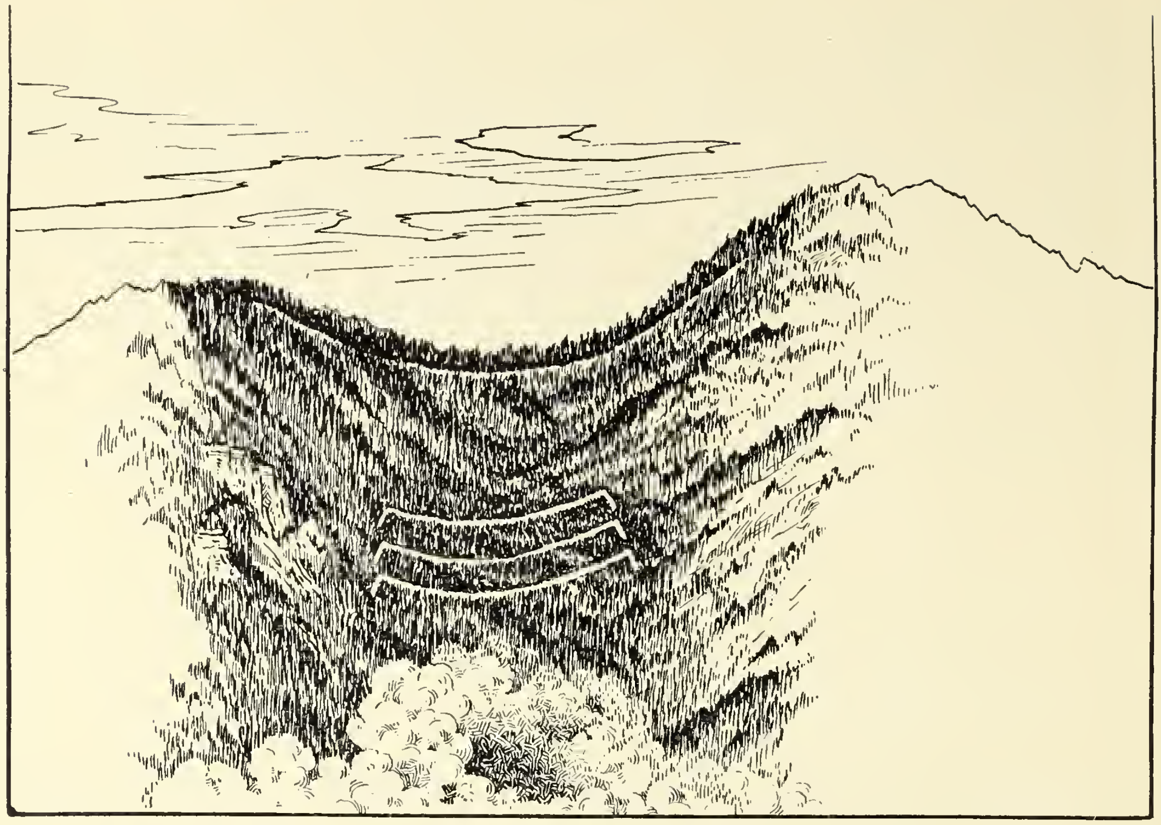
When such a point develops and time is available, the backfire may be worked against the wind by, first, setting the backfire on inside edge of the line; second, have backfiring crew fire narrow strips parallel to the line, working back toward the main fire and gauging the width of the strips to hold the crest of the fire within a safe limit. That is, if there is danger of the fire jumping, if a 3-foot crest develops, the width of the strips backfired should be narrowed down so that no dangerous run with the wind, may occur. In heavy winds these strips must be very narrow. Often 4- or 5-foot strips are advisable in locations that are directly exposed to the wind. (See sketch 1.)

Problem 2

If the fast running point does not allow sufficient time to handle, as above described, the advancing fire may be checked by "buffer" lines and and time gained thereby to complete the backfiring work. This system is shown by sketch 2, where the fire is advancing over fairly level ground. The "buffer" line idea is based, first, on the necessity of disposing of fuel ahead of the fire; and second, on setting up convection currents that will tend to arrest the velocity of the main fire and bring it to the ground. Three buffer lines are usually sufficient to do this in heavy reproduction and pole stands. The line nearest to the main fire should be the first built. These lines may be narrow, just wide enough to hold the backfire until it has gained sufficient

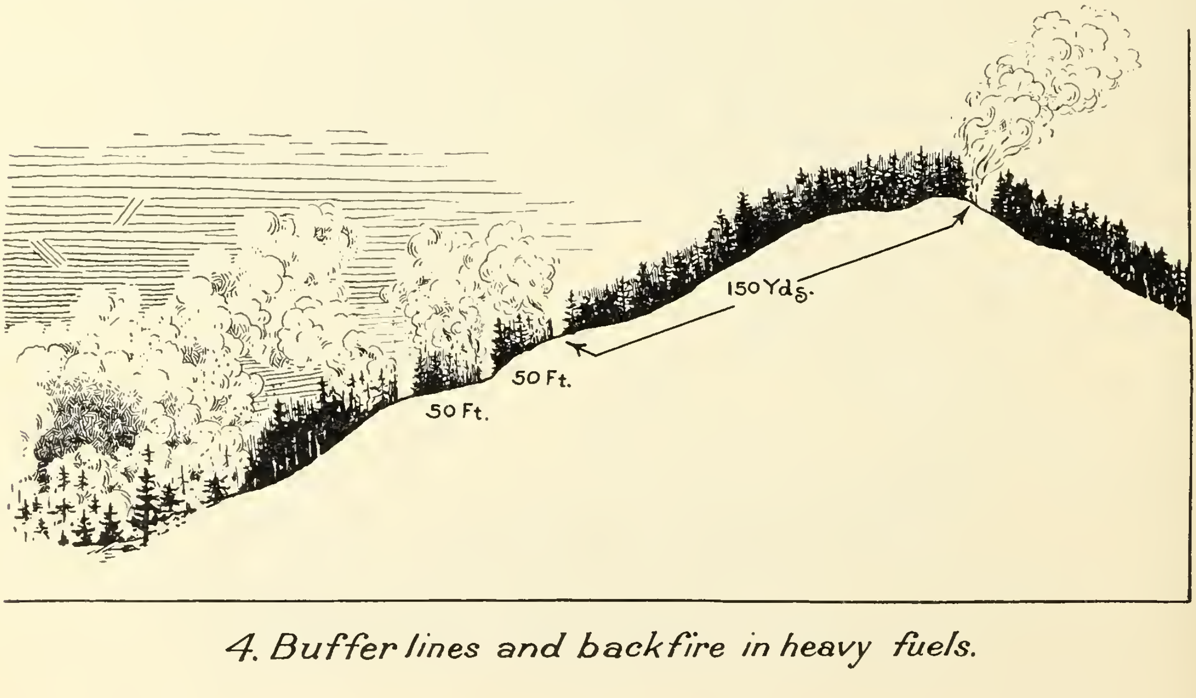


2. Use of buffer lines to check fast running fire.



3. Buffer lines in place to check fire
(Fire line on high ridge)

volume to create a strong draft, and they can be quickly constructed. The lines should be long enough to envelop the point of the fire, with a right angle turn at the end of each line. This right angle should be 20 to 30 feet long, and its use is simply to hold the backfire until it has developed volume in order to create a strong draft. These lines should be backfired as soon as constructed. This work should be handled under the direct supervision of a forest officer in order to be sure that the safety of the crew is provided for.


150 Yds.
50 Ft.
50 Ft.

4. Buffer lines and backfire in heavy fuels.

While this work is being done the main backfire should be steadily worked back from the main fire line, using the strip method previously described.

Problem 3

Where the main fire line crosses the head of a canyon or a low "saddle" on a high divide, these danger spots should be carefully studied before the line is backfired, as the wind is often more intense at these points because of topographic influences. Special treatment is usually required, such as narrow strip backfiring, and if the main fire is very close, "buffer" lines should be provided. (See sketch 3.) If the main fire develops a point here the buffer lines should be immediately backfired in order to lessen the chances of losing the main fire line, as it is certain that the fire will strike the line first at the point where the wind is most intense. The value of a lookout scout at such points should be considered in order to keep a close check on the behavior of the fire.

Problem 4

Sketch 4 shows a side view of the typical fire line set-up on a high ridge, with "buffer" lines backfired to slow down the main fire until the backfiring job can be handled.

Will 1940 be the Eighth "Bad" Fire Year?—When this issue reaches readers in October or November, the answer will doubtless be clear. But at the time this is written, July 16, the prospects are that 1940 will take its place with the preceding 7 outstanding bad years in the history of the national forests. That would make 8 such year out of 36.

After an early 1939 spring so dry that it broke records and gave everyone the jitters, June proved to be exceptionally wet in the 4 far western regions. Early spring in 1940 was not so dry, but June was almost rainless and some large areas suffered from drying winds.

At the date this is written, the North Pacific region is just pulling out of a bad crop of fires, and the Northern region is closing up a battle started by 701 fires from lightning storms on the night of July 12. Newspapers of July 16 report 8,500 men on Northern region fires with hundreds more behind the lines. But as much as 0.72 of an inch of rain has just been reported from one western Montana station. More may follow.

Bad fire years exert a dominant influence on average annual losses, but it is well to view such outstanding years in a perspective of their own. The following table tells the story:

Nationally bad fire years:	Area lost per million acres protected, national forest and private inside (acres)
1910	25,642
1919	12,996
1924	4,429
1926	9,146
1929	5,236
1931	3,368
1934	3,279

If 1940 proves to be the eighth bad year, the loss per million acres protected must be held at around 3,000 acres if the general downward trend is to be maintained.—ROY HEADLEY, *Division of Fire Control, Washington, D. C.*

FIRE PREVENTION IN PENNSYLVANIA SCHOOLS

By Stanley Mesavage, *Colliery Forester*

Mr. Mesavage prepared this article and read it before all school children in Newport township. A Flagg poster had been placed on display on the bulletin board of each school, and after the reading of this statement it was placed alongside the Flagg poster on the blackboard for future reference.

Special Bulletin No. 1

October 1, 1939.

To All School Children:

In order to maintain a growing forest, productive of timber, wildlife, and other scenic and recreational values, it is important that every means of protection be given it.

Tree-clad hills and mountains mean more game for hunting, more timber for our mines, purer water for drinking purposes, and greater recreational benefits. Our forests are now producing what I have just stated above. It is important that YOU and YOU and YOU assure its protection.

We now have better hunting as a result of better forest protection; more rabbits, squirrels, pheasants, quail, and grouse can be found now in our green forests. The scrub trees are disappearing, and taller and straighter trees are appearing.

Remember—that FIRE is the accursed enemy of the forest. It robs YOU of a future timber crop, it destroys YOUR future hunting; it reduces the water table and lowers the height of YOUR mountain streams; it makes desolate YOUR future recreational centers, and most of all, FIRES threaten YOUR community, YOUR home and property, YOUR life and that of your family.

Remember also—that fires threaten the lives of miners and workmen who may be YOUR relatives as a result of the dangerous fire smoke entering the mines. Miners can be smoked out like rats in a hole. Fire may also ignite a coal vein, causing serious loss to YOUR income. For the above reasons, we must not have any grass or forest fires. Fires can be prevented. Small fires always grow into larger ones. DO NOT TAKE ANY CHANCES.

Report all suspicious smokes, and those starting fires to Stanley Mesavage, YOUR Forester, by calling Nanticoke 2105 or 2106, or by notifying the clerk at the Glen Lyon supply store.

MECHANICAL WEAKNESS OF THE FIRE SWATTER

GILBERT SYKES, *District Ranger, Coronado National Forest*

This ranger district depends largely on the swatter as the main fire tool. We have a good many miles of Mexican border facing us, the majority of which runs through rough, steep, and inaccessible country with a ground cover of thick, tough bunchgrasses and browse. Throughout this area the swatter has proved to be, by far, the most effective tool in fire suppression.

Two main weaknesses, however, have developed with the swatter. The first, a question of mechanical failure, is the more serious, and frequently occurs at a critical time during attempted fire control.

This trouble takes place in the metal supports that hold the belting to the handle. Breakage occurs either at the point where the metal shank which runs up into the handle is held fast in place by a rivet, or, more frequently, at the first rivet hole out from the handle. Sometimes the second rivet hole gives way, but this is not quite so serious as failure at the first hole, for if it occurs at the inner one, it is only a matter of a very short time until the break also takes place on the opposite side of the swatter at the same point.

The second weakness is a matter of the thickness and rigidity of the belting itself, and may be overcome through more stringent specifications by central purchase. Some of the swatters received are only three-sixteenths of an inch thick, others are a full quarter inch. The former are somewhat better than worthless, but not much. On a hot fire line they become more flexible and develop a sort of back-lash which makes it almost impossible to strike the ground cover with the flat swat necessary for effective "swatting."

The swatter is a fire tool that can be carried through rough, steep country with considerable ease, and, what is perhaps quite as important, with safety to the carrier and those near at hand. In much of the steep, rough, and rocky bunchgrass country on this district it is far ahead of any other tool used in suppression work. Once the grass is out, the line is built; no slow trenching and scratching down to mineral soil where none exists in the first place. The swatter also lends itself very well to the one-lick method, and the rate at which a grass fire may be checked with swatters using this method is certainly worth investigating. This is even true where a moderate amount of browse and trees exist. If some of you are inclined to doubt this statement, as I know many will, just give the swatters a trial, under a good severe test.

As I see it, the mechanical failure is not very much of a problem to solve. I believe the answer is simply one of using heavier metal half round. At present this is half an inch wide, and the rivets used come so near to the edges that there is very little metal left between the holes and the edge of the half round. I believe that ¾ half round with a backing strip of ¾ by ⅛ would solve the problem. The same method of anchoring the metal into the handle could be used as long as the wooden handles are of the larger size, these being a full inch and a quarter. The size of the belting seems to be best when the dimensions are 12 inches by 12 inches by ¼ inch.

Swatters lately received made by the Council Tool Co., of Wananish, N. C., seem to be quite as good as, or superior to, any others so far sent to this region. They have good stiff belting, the handles are full size, and the general workmanship seems to be competent. However, they are made up of half inch half round steel, and breakage is occurring on the fire line as it does with others of inferior make.

A good swatter is a fine tool to have on a grass-type fire, but it is disconcerting to find only a stick left in the hands and a floppy piece of belting hanging on by one corner while a hot fire is doing its best to get away. At any rate I believe the trouble is worth fixing.

Region 4 Plane-to-Ground Radio Communication.—Last summer Region 4 took radiophone I–25 and mounted it on a 1 inch by 24 inches by 40 inches board. Just below the transmitter the power supply was mounted, and just over the transmitter a motorola receiver equipped for push button tuning was installed.

This completed assembly was provided with four angle iron feet spaced so that the holes through the feet would fit the bolts used to hold in place one of the chairs in a "Travel-air" plane. The completed assembly weighs approximately 65 pounds, and can be installed in a ship in 10 minutes. It is so arranged that the pilot can operate it, if he so desires. An antenna reel was provided so that the wire could be fed from the bottom of the ship. The airplane was both shielded and bonded.

The first test conducted with this unit was started from Cascade on the Payette. The Idaho, Salmon, Challis, Payette, and Boise Forests were asked to stand by for calls from I–25.

As soon as the plane was in the air contacts were made with all these forests. Distances involved were from a few miles to about 100 miles. Contacts were 100 percent effective, and loud speaker reception was had in the ship.

While flying over the Idaho and Payette forests, contacts were made and maintained with SP sets on the ground. During the test flight we were informed by the Salmon that the Missoula radio station desired to contact I–25. This contact was immediately made, the distance being about 140 to 150 miles. They were rather surprised at the signal strength from the ship, and so were we.

During the field season of 1939 this unit was used considerably over the fire forests in Region 4 and proved entirely satisfactory. It is planned that this year use be made of the same unit in the same way.—FRANCIS WOODS, *Communications, Intermountain Region, U. S. Forest Service.*

Use and Misuse of Pumpers.—One veteran fire boss in a Western region has suffered so many times from misuse of pumpers that when the subject comes up he invariably responds with a heated statement that if he could get all the pumpers in the world together he would like to take them out to sea and sink the ship. In his calmer moments, however, even this man would probably recognize that pumpers have a place in fire suppression. The majority of fire-control experts would certainly not want to do without them. But it is astonishing how many times an observer finds pumpers being misused in more or less ludicrous ways. Even after many years of experience and training, one Board of Review report on a 1939 fire finds it necessary to devote a paragraph to the unwisdom of taking time to lay a hose line which did not result in much accomplishment—less in fact than if the man-hours expended on the pumper and the hose line had been used in more efficient forms of initial attack.

BLITZKRIEG FIRE SUPPRESSION TRAINING—THERE IS SOMETHING NEW UNDER THE SUN

K. D. FLOCK, *Personnel Management, Region 1, U. S. Forest Service*

Twenty fire suppression overhead men from the regional office spent long hours in training at and around the remount depot on June 27 and 28, 1940. Many of the men had been fighting crew fires for over 15 years and were somewhat skeptical when they were promised a session of 100 percent new wrinkles for two solid days, but before the final bell was rung they agreed that the bag could still hold new tricks.

The first morning was spent in conference under leadership of Clayton Crocker. The discussion concerned new techniques of fire line construction, the merits of various systems, and detailed announcements of the high-speed program.

The afternoon was given to Gordon A. Rice, of the Pacific Marine Supply Co., makers of Pacific pumpers. Gordon is one of us, since he started out as a hard-bitten smokechaser after having spent his youth on a ranger district in this region. He put on a splendid demonstration of the proper use of water on fire. A hot fire was started in heavy slash fuel, and when it became a 40 man-hour smokechaser blaze, Gordon jumped into it and put it out cold in 20-odd minutes with one nozzle from a type "Y" Pacific pumper. No one in the group ever saw a nozzle used properly before, and several men "fessed" up that their ideas of water on fire were entirely revised.

The second day was really eventful. A CCC crew had been trained by Crocker and Flock in the "progressive step-up" method of line construction. They put on a demonstration in open country so the group could see the mechanics of the system.

Al Austin put out a cheatgrass fire with his rotary use of manpower; Axel Lindh and H. T. Wicklund put on a show in use of the improved Bosworth trencher. Then the whole crew went down Butler Creek to the spot where an empty-handed group of camp bosses were to serve a hot dinner. With no food or dishes, this group of fellows looked pretty silly until Crocker gave them a sheet of paper out of which by magic they served a hot dinner for 50 men, with all the trimmings, in jig time.

Apgar furnished an SP set, so by reading the simple directions furnished by Crocker, these camp boss trainees soon had the hot dinner ordered from Missoula by plane. It was with mingled skepticism and awe that the group watched neat brown packages being dropped at their feet under the silken chutes. Of course, they all predicted that the food would consist of badly shaken hash and canned prunes. Out of four drops, however, there came braised beef, mashed potatoes, peas, gravy, fruit, fruit cake, coffee, bread and butter sandwiches, and 13 gallons of ice water. All the food was steaming hot, and no spill or breakage was experienced. There were no containers or utensils to carry out. They were either paper or made of cheap material. The details of this system can be learned elsewhere, but it is sufficient to say that it was an eye-opener, when one considers the many man-killing walks from fire to camp and back when every ounce of energy is needed to fight fire.

After the noon dinner the "progressive step-up" method was demonstrated by three squads of CCC men in actual fuels. The trainees were surprised at seeing line push through the woods faster than it had been seen before and with such precision.

A tough chance was blazed out for the Cletrac 35 brush buster through down logs, stiff grades, and in heavy brush. Many bets were won and lost on the time that would be used to make a line 27 chains long in the jungle, and to the surprise of many the job was sewed up in 25 minutes by the machine. The experts estimated that it was a 4½-hour job for 25 men. "No wonder Hitler's men went so fast through obstacles on his western advance," said one of the trainees.

As side issues, the trail scooter and mule-loading exhibits were put on in the evenings at the remount.

The consensus was: "It was a good school, Clayton, and we were surprised because there were so many new things."

Fresh Emphasis on the Importance of Volunteer Cooperative Suppression Crews.—In Board of Review analyses of 1939 fires the potentialities of volunteer suppression crews in small towns and villages receive special emphasis. In many places grass fires starting within striking distance of such communities spread with such speed that nothing but the quickest possible attack can hope to prevent a run over a large area and into timber or watershed land above the grass. It is often impossible to keep paid suppression squads, even CCC crews, constantly standing by ready to go with the necessary promptness and speed. But we know from past experience that when the proper interest and enthusiasm is generated, a volunteer crew of businessmen and workers in small towns can turn out to such fires with all the traditional speed and vigor of volunteer fire departments. The famous work of the Crag Rats at Hood River, Oreg., before the days of the CCC, is an illustration of the possibilities of such crews. One important idea emphasized in 1939 reports is that the function of such a volunteer crew should often be to go to the fire and work only for the first hour or two, until fire-control officers have had a chance to organize a crew from less readily accessible sources. The desired type of action from volunteer town and village crews might be far easier to get if the men knew that they could be back at their work in a few hours. With their working clothes always kept where they could be grabbed instantly and with the thrill which comes from a fast run and a fight of limited length, such crews of village businessmen and workers might find such a form of service not only within reason but an exciting and pleasing change from their routines.

Output Per Man-Hour.—Board of Review reports are beginning to comment on the curious fact that fire bosses and inspectors are so often insensitive to the rate of output per man-hour on the work for which they are responsible. One report says: "We need to know more about the actual suppression work on the line if improvement in production per man-hour worked is to be obtained. The production of 0.09 of a chain per man-hour tells its own story when compared with standards set by regional judgment through the years and indicated in the dispatcher's guide. The problem will be solved by better methods of organization and fire fighting and a reduction of walking time for work crews."

COMMENT ON "CHECK OF CENTRAL STATES FIRE-DANGER METER"

By H. T. Gisborne, *Northern Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service*

Danger measurement is not an easy subject. But neither is it something which can be left wholly to fire research men. Every man who is responsible for fire control management needs to understand at least the strong and weak points of theories and methods now in use. No one except administrative managers can decide the number one question—exactly what use or uses do we want to make of such measurement systems—but that answer has not yet been fully worked out.

The author, a pioneer in this field, sets a good example by offering comment and criticism on a previous article. Fire Control Notes cannot completely fulfill its role without an abundance of such comment, either directly constructive or merely critical, or both.

Designers of fire-danger meters should have been interested particularly in two statements made by Reynolds and Bruce in their article in the April 1940 issue of Fire Control Notes, page 79.

The authors assert that "As generally used, the lowest danger-class on any meter indicates weather conditions during which fires will not occur. Since 18 fires have occurred here [in 752 days studied] on days of danger-class 1, as this meter is now graduated, the meter should be regraduated so that class 2 will include these days."

In designing the Region 1 meter class 1 was used as the lowest, rather than class 0, for three reasons. First, there are almost no conditions under which forest fires cannot originate. We have had rare cases of fires burning through the crowns or in snags with snow on the ground. Lots of fires originate during the pouring rains of thunderstorms. Hence, there really is no such thing as class 0, if that is to mean *no chance of fires starting*. Use of class 1 admits that there is always a very small chance of fires starting, though they may not spread far.

Second, if there were certain rare conditions of absolute safety from fires there would be no present advantage in segregating and distinguishing them in one class. The administrative organization of any timber protective organization is always adequate to handle freak and rare cases that often require only a report after the officer has learned that the fire occurred.

Third, class 1 was preferred to class 0 in order to escape mathematical difficulties inherent in the use of zero.

Reynolds and Bruce raise a good question which should be answered uniformly for all regions: Should the lowest class of danger in a scale designed primarily for administrative action include *only* those conditions when forest fires can neither start nor spread? My personal and present vote is "No." When we get a national scale of 0 to 100 percent, I might vote "Yes."

For the other end of the danger scale Reynolds and Bruce raise a similar question by asserting that "also on most danger meters, only about 1 day in 100 is in the highest danger class." I do not see how such a statement can be made on the basis of only a few years of measurement. The highest class of danger shown by a meter must represent the worst probable (perhaps worst possible) conditions at a single station, if that danger scale is to distinguish that day from less bad days. The frequency of occurrence of that condition is difficult to determine until records covering a normal distribution of easy, average, and bad years has been accumulated. A minimum of 10 and usually 20 years is required to determine a dependable meteorological normal.

Reynolds and Bruce contend that as there were no days of class 7 and only 2 of class 6 in the 2 years covered by their records the meter should be regraduated. Is it not possible that these 2 years were easy or average, and that with the advent of a really critical year plenty of class 7 days would be recorded?

This raises another basic question concerning danger-meter design. Should the meter be made to distribute the frequency of occurrence of the various classes on some preconceived basis, or should the meter rate all possible conditions and the data then be used to determine the frequency? In other words, should we assume the frequency or should we find out what it is? I vote for the latter.

If we ever succeed in designing a satisfactory national danger meter it seems probable that the highest class, degree, or percent representing the worst possible (or probable) for any forest spot in the United States will never be registered by meters in places which never have 40-mile winds, 2-percent fuel moistures, and subzero humidities, all at once. I understand that such conditions have been measured in California. If we save 100 percent national fire danger for this condition most of us will be very glad not to record *any* of it.

New York's Got Rhythm.—The one-lick method receives frequent and favorable mention in The Observer of July 1, 1940, issued to its men by the Conservation Department of New York.

District Ranger E. W. Blue describes one ingenious management device which has not been reported before. In commenting on a demonstration of the one-lick method he had witnessed, he says: "The problem of proper spacing of men (with digging tools) does not appear to be difficult * * * and one crew kept in almost perfect rhythm when the leaders counted loudly and each man struck on the count of four."

While counting aloud to regulate the ratio between licks and strokes would have its drawbacks, it has interesting possibilities. Expert woodsmen, who know their psychology, resort to counting their steps as in pacing, when they need something to relieve the tedium and fatigue of hard monotonous travel in the woods. Perhaps the spirits and accomplishment of a line construction crew could be given a lift by a well-designed device of the same kind.—ROY HEADLEY, *Fire Control, Washington, D. C.*

LINDH'S PROPOSALS CALL FOR A TEST

Comments on A. G. Lindh's Article Entitled "Separating the Good People From the Careless"

By John P. Shea, *Psychologist, U. S. Forest Service*

Mr. Lindh's proposals in the April 1940 issue strike a responsive chord with me. They follow in general the methods employed by traffic experts to prevent automobile accidents. If we carry them out we may find, as the traffic people have found, that such methods of educating the public cost much in man-hours and money, but are extremely effective.

If it is decided to carry out Mr. Lindh's proposals, let's make up our minds in advance that careful implementing and systematic follow-up will be necessary.

An important question yet to be answered is: How can we separate the sheep from the goats before they go into the forest?

I make the following suggestions:

After education of the public has been given along the lines laid down by Mr. Lindh, a test should be made in three phases.

Phase I.—Do they *know* it right?

Make and give a test for "goatiness." Such a test will aid us to weed out those who fail to pass it, and to certify only those who do. For convenience and time-saving, the test may be in the form of a check list—with questions which the candidate must answer. This check list should closely follow the training course and text that Mr. Lindh specifies.

In check list form the test can be administered to groups as well as to individuals. Each candidate should be given a mimeographed copy of the check list to fill out. He should show that he knows a sufficient number of right answers before he passes this phase of the test.

This is only preliminary to the main part of the test. I am skeptical of mere questions that may be gibly answered. Habits must be checked also, if we are really going to separate the goats from the sheep. Knowing the right answers and doing the right things in the forest may be two entirely different matters. Habits are strong. So, the candidate's *habits* should be tested. If our instruction has made the candidate a safe person to go into the forest during the fire season, this second phase of our test should show it. It should reveal specifically whether new, desirable habits with matches and smokes and campfires have actually been started.

Phase II.—Do they *do* it right?

This "doing-it-right" phase is an important part of the step to separate safe people from unsafe people in the forest. In this phase of the test the examiner has collected the check lists from the candidates. The examiner puts before the candidates certain test materials, match, ash tray, cigarettes, etc., and instructs them to do now what they would do in the forest with the same fire-causing material.

In this phase of the test the examiner should test the candidate by what he actually does with the match, a cigarette, cigar, pipe, ash tray, etc., when these are put before him for his use. For example: Did the candidate break his match? Put cigarette stub in ash tray, etc.? The test situation here should, as nearly as possible, simulate actual outdoor conditions.

The examiner now rates the candidates on what he observed of the candidate's habits with matches, cigarettes, etc. throughout the entire period of instruction and testing.

When habits are still wrong, the examiner withholds certification or permit until candidate actually *does* the right thing.

Those candidates are certified who pass both phase I and phase II of the test.

Phase III.—Will they keep on doing it right?

In this phase of the test the examiner hands to the successful candidates certificates or permits duly signed by him or by a forest officer. The certificate should carry also a brief list of essential things to do in the forest in the way of fire prevention and cooperation with the Service. The candidate should then be asked by the examiner to read the certificate in full, and if he agrees to abide by the program laid out therein to sign the certificate in duplicate. One copy is kept by the candidate, the other is returned to the forest officer.

One provision in the certificate should state that in case a fire breaks out while the permittee is in the forest, he is to cooperate with the forest officer along lines indicated, reporting, suppressing, etc. It should be stated that in case a fire breaks out while certified persons are in the forest, they may be called on to give an account of their time and activities while in the forest.

In this way, the certified persons would clearly understand that the privileges they enjoy in the forest also entails obligations on their part.

The foregoing suggestions to implement Mr. Lindh's proposal are designed to be a sort of education in fire prevention that goes clear through to habit changing. It is designed (*a*) to educate the public in fire safety; (*b*) to separate the good people from the careless, and certify only the good ones; (*c*) to obtain the cooperation of the certified persons with forest officers; and (*d*) it provides the Forest Service may have a hold on the people who are certified during all the time they are using the forest.

Forest officers in the field may see many ways of correcting and improving these suggestions.

MORE COMMENTS ON LINDH'S SCHEME

LEE P. BROWN, *Training officer, Rocky Mountain Region, U. S. Forest Service*

As I get it, Lindh proposes to test the public and issue a certificate or permit to come and go in high hazard areas.

The following arguments parallel to some measure the arguments which can be made against any law, but which do not stop the passage of laws.

1. People can pass this test 100 percent, or any test we can devise, and still start fires. Regions 5 and 6 both have had cases where timber operators, local residents, and even trusted employees of the Service have been found to be careless with fire. Under such conditions permits to enter and be within a high hazard area would defeat the very purpose of control.

2. If an area of high hazard exists and there is reason to close the area to public travel or to smoking, campfires, etc., isn't it parallel to the police powers of the State? Closing roads to travel during existence of hazardous conditions; closing areas to travel for the benefit of special use, such as parades; routing travel to and from ball games during heavy traffic are similar examples. Exceptions are not generally made in these cases because to do so would defeat the purpose of control.

3. Some exceptions cannot be made because of the excessive cost of administering the area under these conditions. Several million people visit the forests every year. All of them would have a right to demand the test. For example, say we close a number of thinning areas in the Black Hills. There are several thousand, say roughly 20,000, in and adjacent to the area, and possibly 100,000 visitors who spend some time there. Now then, suppose only 1/10 demand the right of test. We have the cost of testing 12,000 individuals and the cost of maintaining an intensive patrol to check those who have permits and those who have not.

Now, suppose we close areas to campfires and smoking on the Roosevelt and Pike, which are adjacent to heavy population centers, as we did last year because of drought. What sort of an administrative problem are we setting up in saying: "You may but he may not?"

4. It seems to me that testing *habits* is a vital factor, as witness our ash dumping fire at the training camp last fall. Last summer the key fire warden on one of our ranger districts caused a smoker's fire. He smoked infrequently; he suffered a momentary lapse of caution. Result—a fire.

5. The mere fact that I never have set a forest fire, although I have spent years living and working in the woods, is no assurance that I won't, but it is the best exemplification of correct habits you can have. Of what value is past record in a high hazard area?

6. After all, it seems to me that the best criteria are the fundamental reasons for the restrictions. Is the restriction necessary because of

critical conditions on the ground when all possible risk must be removed, or is it necessary because of high and frequent risk caused by human occupancy with hazards normal or low? The questions of risk and hazard are deciding factors. No one is allowed to smoke in a powder magazine. Signs of "Employees only" prohibit strangers or visitors from entering manufacturing plants or construction jobs. Within the plant or on the job are signs "No admittance," "Danger, high voltage," "Stay out," etc. The mere fact that an employee is safety-minded does not gain him entrance to areas of high hazard. The necessity for his presence, in spite of the hazard, puts him there. All other employees are not permitted there, but are kept out by a watchman, foreman, or by the crew itself. It is a case of self-defense—protecting themselves and protecting each other. The outsider always adds materially to the risk of accidents.

Fire Reports, Errors, Headaches, and the Law of Diminishing Returns.—When the new Form 929, Individual Fire Reports for 1940 are all punchcarded and run through the tabulating machine, the Forest Service will have a brand new statistical tool to work with. But the value of this new statistical information will not be limited to current use. Twenty-five years from now, management and research men will be using the new form of fire statistics to discover trends, draw conclusions, and develop new ideas. Will the men of 1965 say of the men of 1940, "They certainly set a high standard of accuracy, and when they adopted a set of instructions, they certainly followed them"? Or, will they say something about the inability of the men of 1940 to do simple arithmetic, and read and follow instructions?

The answer will depend, first of all, on the mental discipline of over a thousand widely scattered men and women who make and code individual fire reports. Every report is a mental test of each person making or coding or checking a report. If he reads the instructions carefully, reasons correctly therefrom, and has trained his hand to record accurately what his mind has directed, he will be upholding the dignity of this kind of hard work as well as winning applause from all users of fire statistics. There is no finer team work than that in which many widely separated individuals are conscious of the whole team and play their own individual parts where the inspiration of close association is lacking, as in a job like this one.

To catch the inevitable few mistakes and get the new 1940 coded fire reports onto the punchcards with an irreducible minimum of error, it was at one time planned to assign an experienced fire man to the job of making a last final check in Washington. This plan had to be given up and the job added to Miss M. A. Bell's other duties.

On July 1 she had completely checked 659 reports and written letters calling attention to errors discovered. But by this time there were over 1,800 unchecked reports awaiting her attention. Something had to be done. The plan adopted was to rush the accumulated reports through with no systematic check except to see that the "code numbers" columns were all filled in with correct numbers of legible digits. Occasionally, both an administrative entry and the code number are left blank, despite all the checking at forest and Regional offices; or the number of digits in the code numbers column does not match the number of columns on the punchcard assigned to the item. Mrs. Moler, the machine operator, cannot be expected to take time to puzzle over such slips. In this fast check, Miss Bell also made sure that the cause entries conform to instructions, and checked "area when controlled" with areas entered in the damage block.

After the accumulated pile of unchecked reports was rushed through, a form of spot check was adopted. As time permitted, 100 reports were taken at random from each region in rotation, given a thorough check and the region written about errors found, if any.

This form of spot check is by no means all that is desirable. Too many errors are still showing up. But it is hoped that reports coming to Washington will be so well done in the future that the law of diminishing returns would not justify any more thorough checking.—ROY HEADLEY, *Fire Control, Washington, D. C.*

IMPROVEMENTS IN BACKPACKING THE PORTABLE PUMPER EQUIPMENT

FRANK H. ANDERSON and G. W. KRUSE, *Camp Superintendent* and *Junior Forester, Superior National Forest*

Road and trail mileage and water using equipment on wheels have so increased that it would be easy to neglect the instances when nothing will really serve except a portable pumper with plenty of hose and fuel all carried to the right spot on men's backs. Pumpers and hose lines seldom pay in initial attack, but that does not mean there is no need for ways of carrying them into the jungles with the highest attainable ease and speed. Quick and easy delivery of a pumper to a mop-up job in heavy fuels may often provide the only way to prevent a fire that "jumped the line" and made the headlines as a big destructive fire. The authors have something to show for their search for better equipment for transporting pumpers and hose.

Those individuals who have had experience in backpacking marine pumps, hose, and gasoline over rough terrain in packsacks or on ill-fitting packframes will no doubt be interested in any improvements offered to make the job easier and less back-breaking for the man under the load.

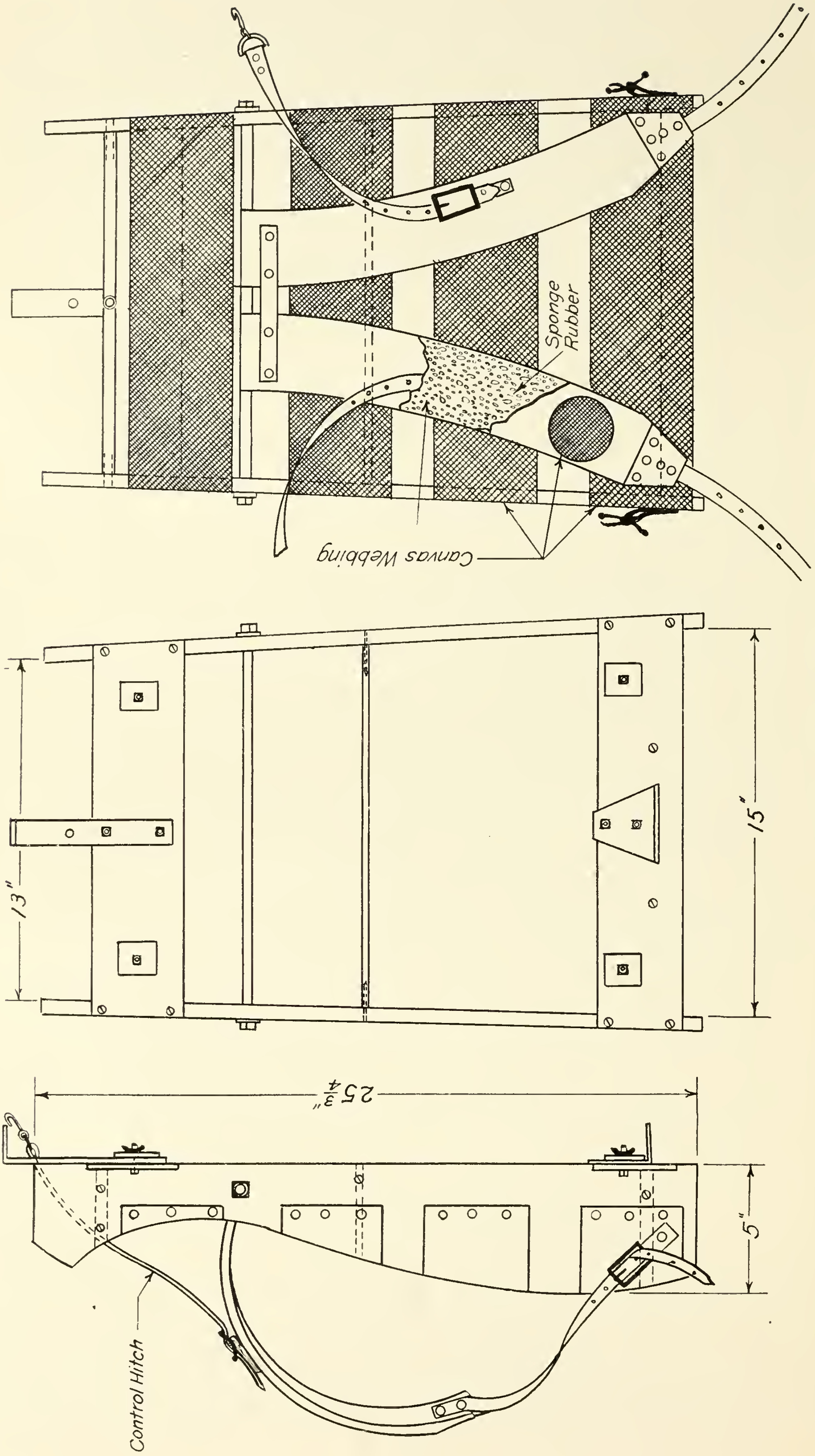
The chief complaints on using the common type packframes or packsacks are:

1. The load is carried too low.
2. The bearing point on the shoulder cuts down normal circulation in the arms.
3. The weight is not distributed over the back.

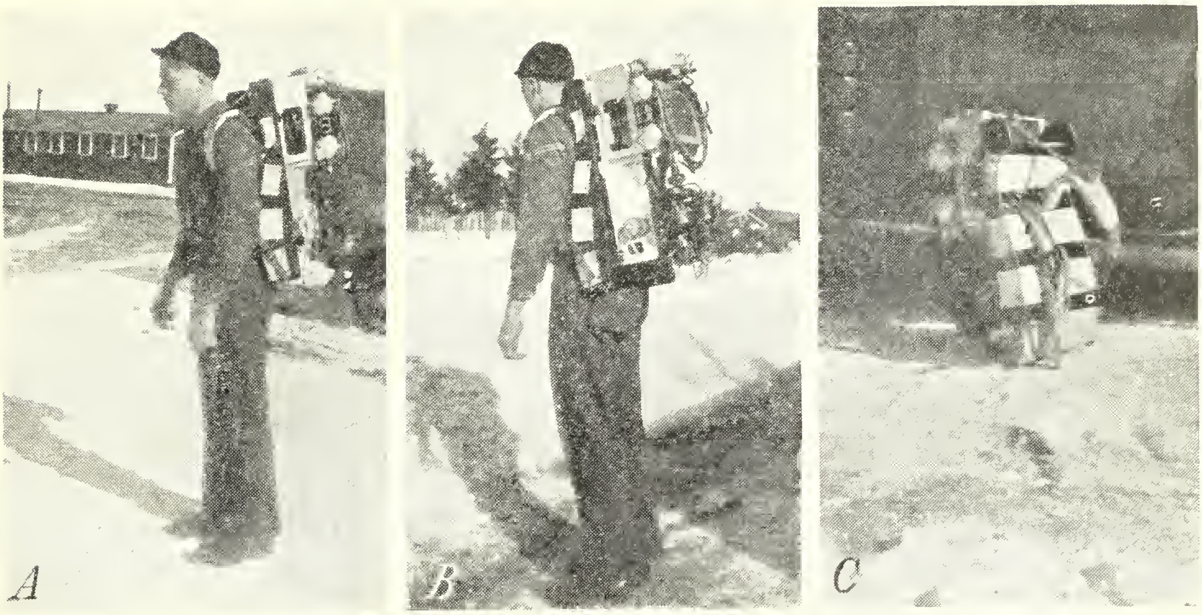
After a year of study and experiment, the authors offer what they believe to be a solution to the problem.

The new form-fitting packframe for marine pumpers is designed to fit the curvature of the back, thus allowing a more comfortable distribution of weight on the packer. The load is slung higher than on other frames. The padded packstraps help to eliminate the cutting off of blood circulation that has so often produced a numbness in the arms of the packer. The adjustable control hitch, which fastens to the packstraps and to the base of the pumper, gives the packer absolute control against swaying and holds the load in the proper vertical position in such a manner as to eliminate most of the back drag. The addition of a head strap, which eases the load a bit more, is optional. Any type of hitch, clamp, or bracket may be used in attaching the pumper to the frame.

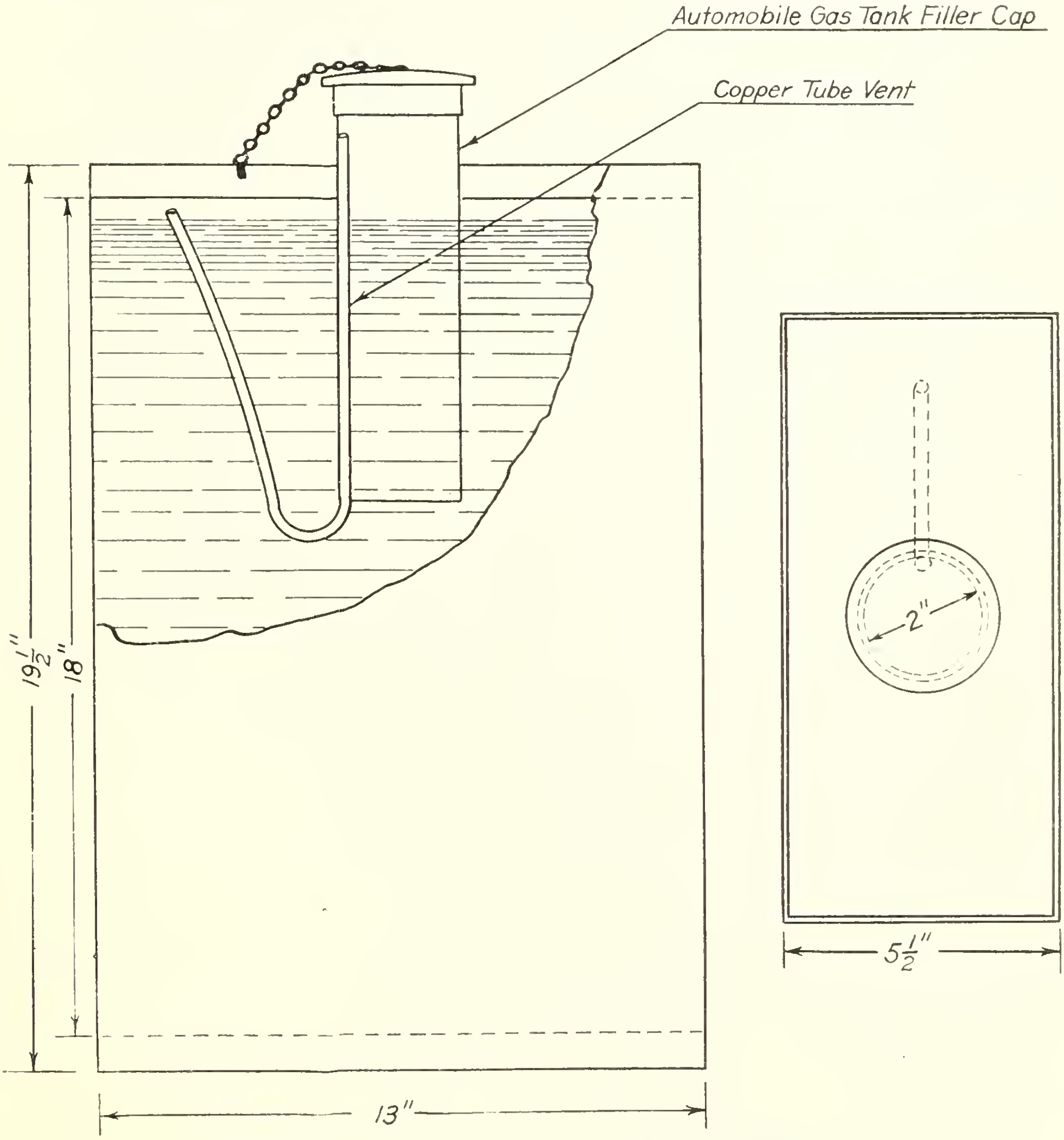
A new type of hose pack enables the packer to carry and distribute 400 feet of linen hose with ease. The hose is connected and lapped on the frame and held in position by door springs. Hose can be strung out about as fast as a man can walk. This system is a time saver where minutes count, as it eliminates the time used in uncoiling the hose by hand. Hose can be strung out through heavy cover very quickly with-



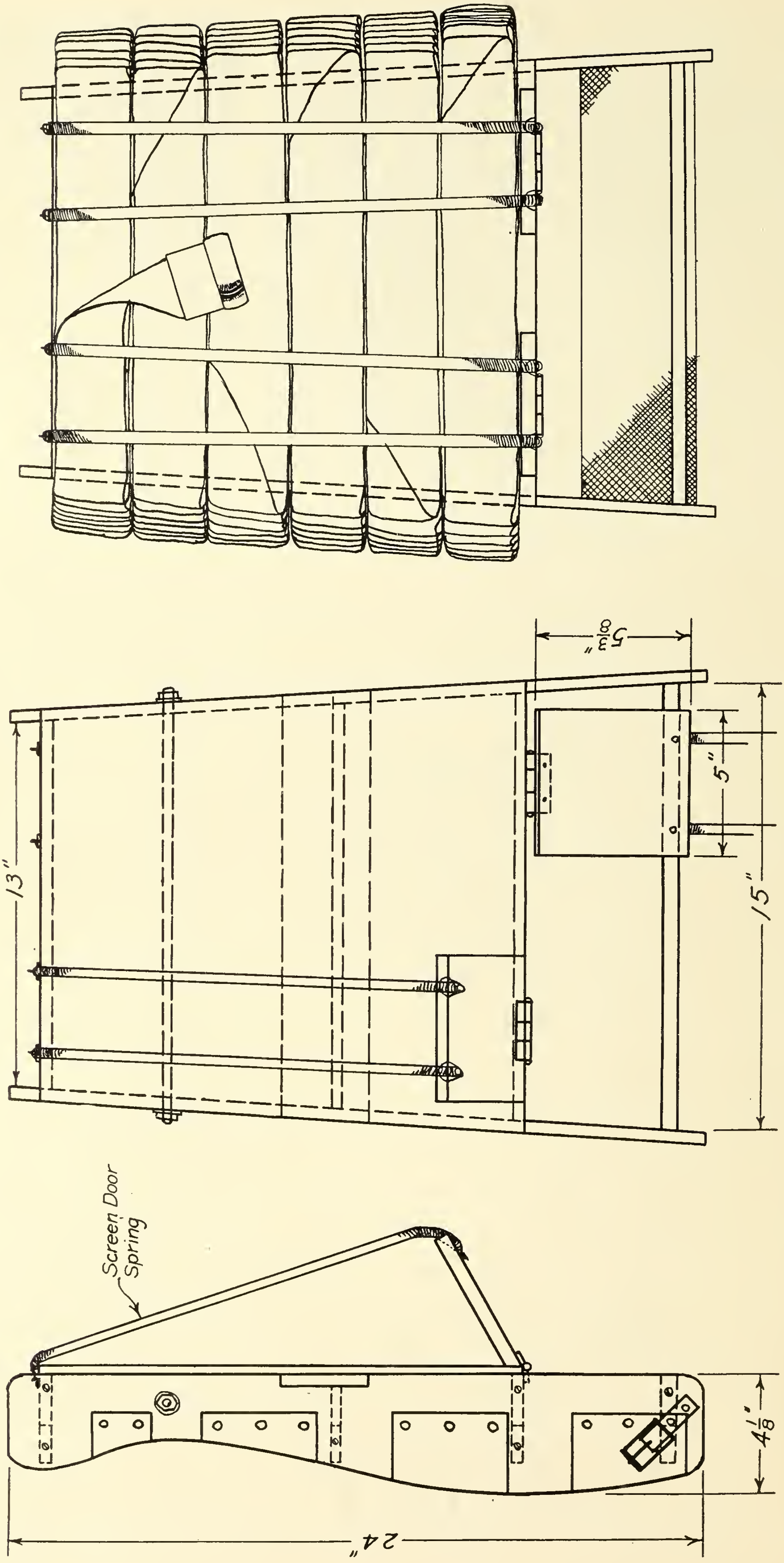
Marine pump pack.



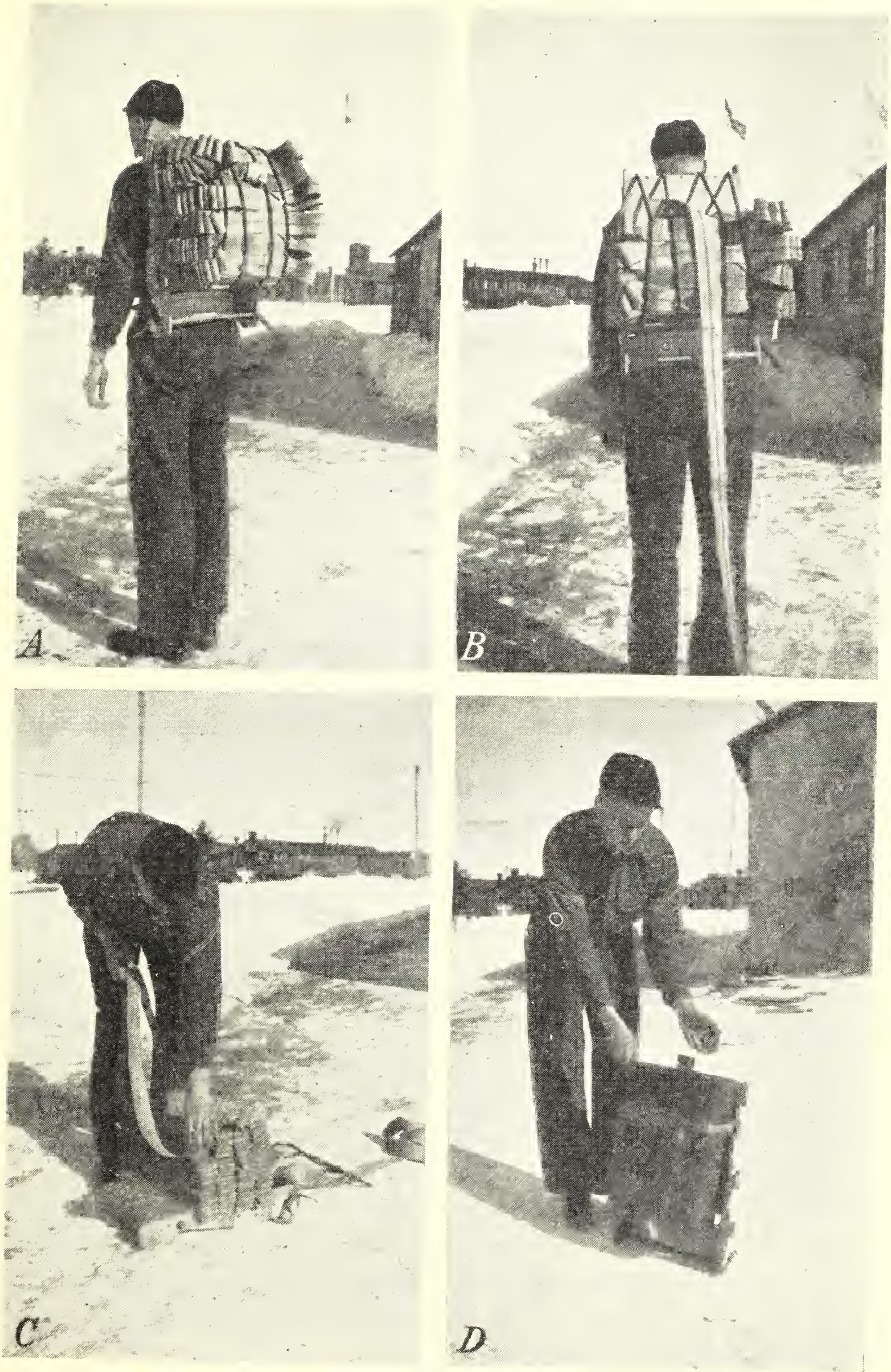
A, Side view showing the position of frame on packer; B, Rear view showing clamps for holding pumper to frame; C, Front view showing adjustable control hitch, pack straps, and webbing.



Portable splash proof gas can, 5-gallon capacity.



Hose pack.



A, Rear view showing position of hose pack on packer; B, Rear view showing lapped hose being laid out—note door springs; C, Illustrating the manner in which the hose is lapped on the frame; D, Rear view showing gas can mounted on frame—note filler cap.

out the use of a brushed line. This form-fitting frame can also be equipped with the adjustable control hitch and head strap if so desired.

The new splash-proof gas can for transporting pumper fuel has a capacity for 5 gallons of mixed gas and is mounted on a form-fitting pack frame.

The automobile gas tank filler neck and cap prevents the leakage of fluid onto the back of the packer. The filler neck acts as a baffle plate and prevents splashing close to the filler cap. The copper tube vent must be installed with this type of can to allow air to escape while filling the container.

The gas tanks have been removed from the pumps on the Superior National Forest, and gas is siphoned directly from the pack can to the carburetor. This in itself has the advantage of eliminating the necessity of stopping the pump so often to refill the tank.

It will never be possible to make packing pump units easy. However, any method which can be devised to cut down the excess effort used in getting the equipment to a fire will mean faster attack by fresher men.

How Many Dimensions Has a Fire?—In reviews of the McVey fire of 1939 on the Black Hills and Harney National Forests, the point was made that the vertical dimension of a running fire is often more important than its area or length of perimeter. Another 1939 review talks about "depth of perimeter as well as length of perimeter." The point is that when a fire burns into "goat rocks," the fuels may be so spotted and so exposed to the wind that the job of making a control line has to be one of putting out, isolating, or mopping up fires spotted over a considerable area rather than making a continuous barrier at the outside edge of a fire. The point is made that this is important to consider in the calculation of probabilities, and that as we develop rules or guides which can be more universally used this information should be made available to the men responsible for dispatching to fires which may burn into this kind of country.

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